

VOL XXXI. NO. 10

AUGUST 9, 1938

MEDICAL LIBRARY

PROCEEDINGS
of the
ROYAL SOCIETY OF
MEDICINE



LONGMANS, GREEN & CO LTD
39, PATERNOSTER ROW, LONDON
NEW YORK · BOMBAY · CALCUTTA · MADRAS

All rights reserved.

For
Sex-Hormone Therapy

Antuitrin 'S' is a solution of the anterior-pituitary-like sex hormone obtained from pregnancy urine. The solution possesses both follicle-stimulating and luteinizing properties. Antuitrin 'S' is indicated for the treatment of conditions such as menorrhagia and metrorrhagia, climacteric haemorrhage, habitual abortion, and in some cases of sterility. In rubber-capped vials of 10 c.c.

Theelin (keto-hydroxyoestrin) in aqueous solution has found useful application in the relief of the symptoms of the menopause, artificial or natural, in mastopathia, and in hyperemesis gravidarum. In boxes of six 1 c.c. ampoules containing 200 International units.

Theelin in Oil. For other indications for Theelin administration, notably secondary amenorrhœa, larger doses may be necessary, and to meet this need a solution of Theelin in Oil has been introduced. In boxes of six 1 c.c. ampoules of three strengths, containing 1,000, 2,000 or 10,000 International units.

Theelol (tri-hydroxyoestrin) is similar to Theelin in physiological action, but it is distinctive in that it is stable in the gastro-intestinal tract. This property, coupled with its greater solubility in water, ensures its prompt absorption and therapeutic action after oral administration. Supplied in bottles of 20 capsules.

**Parke, Davis & Co., 50, Beak St.,
LONDON, W.I.**

Laboratories : Hounslow, Middlesex.

Inc. U.S.A., Liability Ltd.







Section for the Study of Disease in Children

President—T. TWISTINGTON HIGGINS, O.B.E., F.R.C.S.

[May 27, 1938]

Dermatomyositis complicated by Calcinosis. — R. H. BAILEY, M.B.
(introduced by Dr. WILFRID SHELDON).

E. A., female, aged 12 years.

Previous history.—Born in Switzerland; first came to England in 1930 at the age of 4 years. While she was here, swellings resembling chilblains developed on the hands and feet and persisted until she returned to Switzerland some months later. On her return to England in 1935 for a holiday the swellings recurred. They were red and painful but did not crack or weep. When cold, her hands felt "burning inside". The swellings disappeared when she again returned to Switzerland.

In England since 1936. First noticed difficulty in bending, whilst living in a damp house at Oxford one year ago. Stiffness began in the back and legs and is now present in the arms also.

Family history.—Father English; mother Italian. Two children. Sister, aged 14, healthy.

On examination.—Intelligent child. Skin shiny over knuckles, elbows, and knees. Arms: Extension poor. Extension of wrists poor. Complete flexion of fingers impossible. Supination and pronation of forearm good. Grip weak on both sides. Legs: Flexion of hip and of both knees very poor. Dorsiflexion of feet poor. Marked thickening of subcutaneous tissues.

Patient developed scarlet fever whilst in hospital.

Investigations.—X-ray report (G. Doel): "There are large calcium deposits in the region of the greater trochanters of the femora (see fig., p. 84). These deposits appear to be in the muscles attached to the upper margin of both acetabuli. The great opacity of the condition suggests that ossification is taking place; this is said to be uncommon in cases of dermatomyositis. A little calcium deposit is seen external to the left knee-joint. No other muscular calcification is observed."

Serum phosphorus and calcium: 24.4.38: Calcium 10.8 mgm. per 100 c.c. Phosphorus 3.8 mgm. per 100 c.c. Blood phosphatase 9.2 units.

Throat swabs: Repeated growth of the haemolytic streptococcus.



FIG. 1.—Showing calcium deposits in the region of the greater trochanters.

Discussion.—Dr. E. A. COCKAYNE said that this patient reminded him of a boy who had come under the care of Sir Frederic Still, with the diagnosis of rheumatoid arthritis. Later on there had not been any swelling of the joints or soft tissues of the hands, but there had been great limitation of movement at all the metacarpo- and interphalangeal joints and, to a less degree, at the elbows and other large joints. There was atrophy of the soft tissues of the fingers, but no true sclerodactyly. The skin over the knuckles, finger-joints, elbows, and knees was thin and scar-like, and from time to time calcareous plaques formed in it and fell off, leaving an indolent raw surface. A calcareous lump as large as a walnut formed over one of the ribs and was removed, leaving a raw surface, which healed very slowly. Other calcareous deposits occurred in the skin of the scalp and sacrum. At the age of 13 a calcium-balance test, carried out under the supervision of Professor E. C. Dodds, had shown no calcium retention, and the calcium and phosphorus in the blood were within normal limits. At this date X-ray examination had shown small calcareous deposits in the thighs, and much larger ones in the lower third of both legs. At the age of 16 the movements of all the joints were freer, though still limited, but there was now severe aortic incompetence. There was no history of rheumatism, and it was decided to take a skiagram of the aorta in order to see whether the valves were calcified. The boy, however, refused the examination and discharged himself from the hospital.

Dr. F. PARKES WEBER said that in many respects this case of "universal calcinosis" resembled that in a boy, aged 15, quite recently described by R. Leriche and A. Jung (*Presse médicale*, 1938, **46**, 809), in which (at length) an operation, comprising thymectomy and parathyroidectomy was performed. Some improvement seemed to have followed the operation. In the present case it would be worth while carefully examining by X-rays for any evidence of an enlarged thymus.

Thyrotoxicosis in a Child aged 6 years. Thyroidectomy.—F. DUDLEY HART, M.B. (introduced by Dr. B. E. SCHLESINGER).

Patricia J., aged 6 years, was a normal, healthy child until July 1937. She had previously been a rather plump, "chubby" child, but then she began to grow taller more rapidly and failed to gain weight. The bowels became loose, and diarrhoea returned periodically for several days at a time. Two months later, in September, the neck was noticed to be more full, and the eyes seemed more protuberant. She was rested at home, but the signs persisted and became more definite. She complained on occasion of a smarting pain in the eyes, "as though somebody had thrown dust into them". She began to lose weight, and on 13.1.38 was sent by Dr. Price to the Royal Northern Hospital under the care of Dr. Bernard Schlesinger.

Previous history.—Infancy perfectly normal. No previous goitre noticed at any time. She has always been a bright, intelligent child, tiring more easily than her



FIG. 1.—Showing enlarged thyroid gland and exophthalmus.



FIG. 2.—Lateral view.

playmates. Always a light sleeper, waking easily; would never sleep by herself or with the blinds drawn. Went to school when 4½ years old, liked the work, and seemed happy there. September 1936: Had mumps, measles, whooping-cough, and "influenza". Ill for four months.

Family history.—Parents alive and well. Mother has had no signs of thyrotoxicosis or goitre. Two other children, aged 7 and 4 years respectively; the younger one has been treated for rickets.

On admission.—A bright, cheerful, intelligent child. Rather nervous, jumping at loud noises. Appetite excellent; bowels rather loose. Marked lid retraction and some exophthalmos. Thyroid gland diffusely enlarged—isthmus and both lobes—and fairly firm to the touch. Mouth and throat healthy. Cardiovascular system: Blood-pressure 113/64. Apex beat palpable $\frac{1}{4}$ in. beyond midclavicular line, diffuse and slapping. Soft systolic murmur heard at mitral and pulmonary areas. Pulse rapid (130–155) with many premature beats, shown on electrocardiogram as nodal premature systoles. Respiratory and alimentary tracts normal. Hands outstretched showed fine tremor, with flexion of wrists and hyperextension of metacarpo-phalangeal joints. Central nervous system: Normal, except for marked exaggeration of all reflexes and some muscle weakness—generalized, but particularly noticeable in calf muscles.

After three weeks' rest in the ward and bromide treatment she had failed to gain weight. Pulse continued at 120–130 (sleeping pulse 90–120). Temperature occasionally rose to 99° F., and once to 99.4°. She perspired freely.

Lugol's iodine η iv t.d.s. was given in the fourth week, and was continued for nineteen days before operation. The pulse-rate decreased to 110–120.

Operation.—Sir Lancelot Barrington-Ward operated on 21.2.38, removing five-eighths of the thyroid gland. The tissue was firm and vascular. The anaesthetic was gas-and-oxygen, given by Dr. Wade after pre-operative avertin. The child stood the operation well, was little upset by it, and ran a slight temperature for only forty-eight hours, the highest reading being 102° F. on the evening following operation. Lugol's iodine was continued for fourteen days post-operatively, the dose being reduced from η iv t.d.s. to η ii t.d.s.

Microscopical report: Epithelial hyperplasia with immature vesicles and budding; changes of a toxic goitre.

Progress.—The child gained 12 oz. in the first ten days after operation, and 3 lb. in the following week. The pulse averaged 92 and never exceeded 110. Premature systoles were less frequent. An electrocardiogram after operation showed little change apart from the slower rate. When seen on 28.4.38 she was still gaining weight, had a pulse-rate of 112 with several extrasystoles, and was generally fit and well. The tremor had disappeared.

Dr. F. R. B. ATKINSON said there were 208 cases of Graves' disease in children 14 years of age, or under, recorded in the literature, and there were many others of which particulars were so fragmentary that they could not be included.

Right Middle Lobe Collapse.—S. D. COURT, M.B., M.R.C.P. (by courtesy of Dr. DONALD PATERSON).

D. F., male, aged 4 years 11 months. Under observation by the Hospital for Sick Children from September 1936.

Family history.—Elder of two children. Mother and father of poor physique but otherwise healthy. Maternal grandfather, who lives in the same house, has a chronic cough; skiagrams of the chest revealed bilateral chronic fibroid phthisis; tubercle bacilli were present in the sputum.

Past history.—Measles, June 1936.

History of present illness.—27.7.36: Admitted to Archway Hospital. Diagnosis "bronchopneumonia". X-ray report: "Dense shadowing at the right root and

inner part of right interlobar fissure." Later suspected to be of tuberculous origin and labelled "epituberculosis". Mantoux reaction positive. 17.8.36: Returned home, against advice. 9.9.36: Admitted to Hospital for Sick Children. The clinical and radiological picture presented was that of a resolving exudate in the right middle-lobe area. 25.9.36: Transferred to convalescent home. June 1937: Discharged from convalescent home. General condition excellent. X-ray report: "Resolution not quite complete". July 1937: Tonsillectomy.

Remained well, apart from a slight unproductive cough, until March 1938. Cough then became more pronounced and general health again declined. 22.4.38: Readmitted to Hospital for Sick Children.

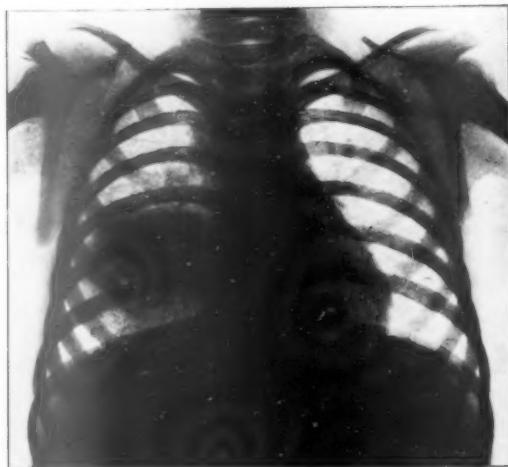


FIG. 1.—9.9.36: Pneumonic exudate in right middle lobe. Note irregularity of outline as compared with collapse shown in fig. 3.

On examination.—Pale child. Height 43 in. Weight 39 lb. Chest: Impaired resonance over right lower lobe with diminished air entry—breathing bronchovesicular with associated bronchophony. Apex beat: 4th left interspace $1\frac{1}{2}$ in. from the mid-line.

Investigations.—Mantoux reaction strongly positive. Sedimentation rate (22.4.38) 58 mm. in one hour; (4.5.38) 29.

Blood-count: R.B.C. 3,510,000; Hb. 70%; C.I. 1.0; W.B.C. 9,600. Differential: Polys. 68%; lymphos. 30%; monos. 2%.

Skiagrams (figs. 1, 2, 3): 10.9.36: Large area of consolidation right base. 10.12.36: Area of consolidation a little smaller. 25.2.37: Very slow resolution. 20.5.37: Continued progress towards resolution. 15.6.37: Incomplete resolution. 25.4.38: Collapse of right middle lobe. 2.5.38: Bronchogram (fig. 4): No filling of right middle lobe bronchi.

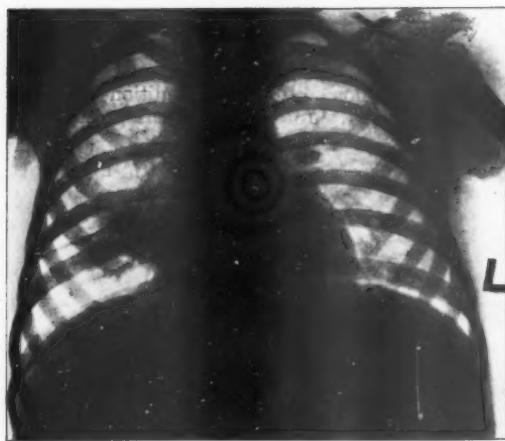


FIG. 2.—22.4.38: Resolution almost complete. Note thickening of interlobar fissure.

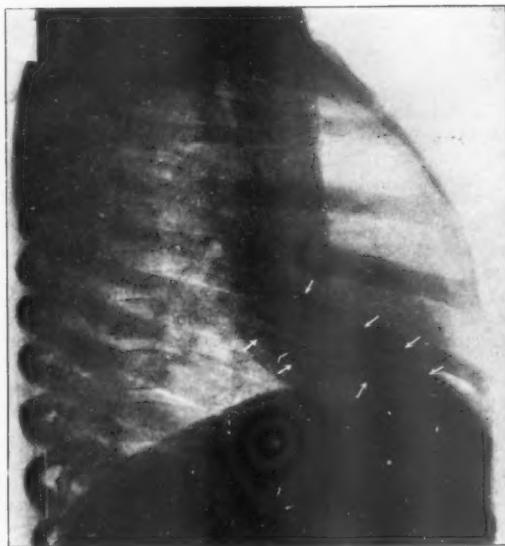


FIG. 3.—26.4.38: Right lateral position. Arrows indicate outline of collapsed middle lobe.
Note retraction of lobe from the sternum.

Bronchoscopy : Right middle lobe bronchus almost completely occluded by granulation tissue. Histological section revealed no evidence of tuberculosis.

Gastric lavage : Sputum recovered was mucopurulent in character; no tubercle bacilli seen. Guinea-pig inoculated : No evidence of tuberculosis.

Lung puncture : Small quantity of blood-stained material obtained. Guinea-pig inoculated.

Comment.—The picture presented here is that of a child now aged 5 years, who, for twenty months, has been ailing but never gravely ill. During this period the



FIG. 4.—Bronchogram: No filling of right middle lobe.

main features have been intermittent anorexia, loss of weight, and slight, but unproductive, cough. Underlying this, radiology has demonstrated a slowly resolving exudate, in the right middle lobe area, with a present residuum of collapse.

The first question raised by the above picture concerns aetiology. Is this a chronic pneumonia following measles or a slowly resolving tuberculous exudate? Although lung puncture and gastric lavage at this phase have failed to provide absolute proof, the age of the child, the strongly positive tuberculin reaction, the

long period of resolution, and the close contact with a case of open pulmonary tuberculosis are taken to favour the latter view. A remark by Reichle is interesting in this connexion :—

"A lobar infiltration of density shown, lasting considerably over a year, and strictly delineated by the outlines of the middle lobe is a distinct rarity in children, except as a result of tuberculosis."

Turning to the pathology : The earlier shadows are taken to represent tuberculous pneumonia. The later skiagrams and the bronchoscopic evidence of bronchial occlusion in the area concerned suggest that the present condition is one of collapse.

The term "epituberculosis" has been avoided, in view of its composite character and debatable position as a distinct entity.

The optimum form of treatment is not certain. At present prolonged convalescence, preferably at the seaside, is favoured, though lobectomy has been considered.

Reference.—REICHLE (1933), *Am. J. Dis. Child.*, **45**, 307; **46**, 969.

Dr. PEARSE WILLIAMS said he thought that to perform lobectomy in this case would be far too drastic. He agreed that the condition had probably begun as an inflammatory lesion which was very likely to have been tuberculous ; the strongly positive Mantoux reaction and the daily exposure to infection from the grandparent were in favour of a tuberculous aetiology. He would advise treatment by hygienic measures, including a prolonged stay at the seaside, and would control progress by radiology at intervals.

Athetosis following Acute Specific Fevers.—EVELYN STARLING, B.M., B.Ch. (by courtesy of E. A. COCKAYNE, M.D.).

M. L., female, aged 5 years and 2 months, is the fourth of five children, of whom all the rest are healthy.

History.—At the age of 2 years she spent six weeks in a fever hospital, having measles, whooping-cough, and bronchopneumonia, in that order. Three weeks after her return home she showed twisting movements of the hands and face ; these were worse when she was excited, and were absent during sleep. The child had no drowsiness or paralysis when she came home. She has had no other illnesses, but has always been a nervous child. The family history is clear.

Condition on examination.—A pale, thin child. Intelligent ; co-operates readily. She shows continual writhing movements of the hands, face, and tongue, and, to a lesser extent, of the shoulders. Her speech is somewhat halting as a result of the lip movements. Teeth carious ; tonsils enlarged and septic ; tonsillar glands enlarged.

In the central nervous system, the only abnormality besides the athetosis is inco-ordination of the left arm, shown by the finger-nose test. The other systems are all normal. The cerebrospinal fluid is normal and its Wassermann reaction is negative, but the Wassermann reaction of the blood is strongly positive, as also is that of the mother's blood.

Differential diagnosis.—This is a case of athetosis—a condition due to some lesion of the basal ganglia. (1) Is it a post-encephalitic manifestation, the encephalitis having occurred silently in the fever hospital or at home ? (2) Is it a manifestation of neurosyphilis and, if so, did the fevers play any part in bringing it to the surface ?

Discussion.—Dr. PEARSE WILLIAMS, drawing attention to the previous history, said that whooping-cough was a cause of convulsions and cerebral damage and disturbance in childhood. Permanent injury might result, and he thought that the athetoid movements in this case might have followed the pertussis, which was a more likely prime cause than either measles or syphilis. He suggested, therefore, that the history of the attack of whooping-cough should be inquired into.

Dr. DAVID NABARRO said that in his opinion the condition was consequent upon either measles or whooping-cough, rather than due to congenital neurosyphilis, because, in his experience, manifestations of congenital syphilis of the central nervous system were nearly always associated with a positive Wassermann reaction and/or other slight changes in the cerebrospinal fluid, which were absent in this case. He had been informed that this child's blood Wassermann reaction would not have been tested had it not been that she was to be shown to the members of the Section, and if her blood had not been tested, the positive Wassermann reaction would not have been discovered. The case therefore exemplified the fact that congenital syphilis might nowadays easily be overlooked because it was either latent or presented symptoms which did not always tally with the recognized symptoms described in the textbooks. The disease was by no means so rare as clinicians usually considered it to be; he (the speaker) had seen 15 new cases of congenital syphilis during the first five months of 1938, in addition to four congenitally syphilitic mothers. He would therefore enter a plea for the more frequent examination of the blood of children when there was any obscurity or doubt whatever about the nature of the case.

Dr. COCKAYNE said that, if the mother's story was correct, the movements did not begin until twelve weeks after the attack of measles, which was too long for "encephalitis following measles". The whooping-cough was a more probable cause of the condition.

Pseudo-hermaphroditism.—URSULA SHELLEY, M.D. (by courtesy of HAZEL CHODAK GREGORY, F.R.C.P.).

George (Doris) P., aged 6 years.

History.—Until 3 years of age the child was brought up as a girl, who had definite feminine characteristics, and was very fond of dolls. The appearance then became more like that of a boy, and the mother first began to notice the penis. Boy-like instincts began to be dominant and the whole make-up grew masculine. The child has been going to school for one year, where he is popular and does well at his lessons. Nocturnal frequency and enuresis have been present in the past.

Family history.—One other child (girl) normal.

On examination.—Well-grown, healthy child. Friendly and co-operative. Voice deep for age. Weight 4 st. 5 lb. 10 oz. Height 4 ft. 2 $\frac{3}{4}$ in. Pubic hair present. The urethra opens at the base of the "penis", which is short and has a dimple at the extremity. No vagina, uterus, tubes, ovaries, or testes, were palpated, *per rectum* (under an anaesthetic).

Investigations.—X-ray: Pituitary normal in size and shape. Long bones slender, but not abnormal. Chest: No enlargement of thymus. Abdomen: No apparent abnormality. Hands rather broad; no abnormality.

Blood-sugar: 0.098%. Curve within normal limits. Blood-count: Nothing abnormal noted. Blood Wassermann and Kahn reactions negative. Androsterone estimation: 12 units. (? increased value for a child; normal for adult, 24 units.)

Dr. COCKAYNE said he had no doubt that Doris was the right name and that the child was an example of suprarenal virilism dating from an early period of embryonic life. The presence of pubic hair, the state of the genitalia, and the girlish mentality were all proofs of this. Hyperplasia of the cortex of the suprarenal glands was the most probable cause. Removal of one suprarenal, or of an adenoma if one were found, would make the child more

like a girl, but could not make him a normal girl. He thought the child would be happier in his boy-like state and advised that no operation should be done. He had given the same advice in the case of a similar child who was under the care of the President and was shown before the Section some years ago (*Proceedings*, 1935, 28, 1073, Sect. Dis. in Child., 69), and he still believed that it was right.

Lymphosarcoma.—R. W. B. ELLIS, M.D.

R. S., a boy aged 8 years.

History.—Six weeks ago swellings were noticed in both parotid regions, simulating mumps. After three weeks more swellings appeared in the neck, and the patient was sent to Guy's Hospital for an opinion. He has been in good general health and has had no pain or other symptoms, the swellings in the neck being the sole cause for seeking advice.

Family history.—Only child (illegitimate). Nothing known about the father, no history of illness on the mother's side.

Previous diseases.—Measles (uncomplicated) at age of 4 years.

Condition on admission (8.5.38).—Glands in the neck greatly enlarged, giving a "collar" effect (tonsillar, submaxillary, anterior cervical, and those in the posterior triangle); largest gland about the size of a walnut. Glands not adherent to skin or deep structures, and not matted together. Similar, though smaller, glands in both axillæ and groins. Spleen palpable one fingerbreadth below costal margin; liver just palpable. No abnormal physical signs in chest, and no glands palpable in abdomen. Temperature 98·4° F. (Since admission there have been occasional spikes up to 101° F.) The child looked well, the appetite was good, and the bowels were regular.

X-ray examination (Dr. Lindsay Locke): No abnormality detected in the chest.

Blood-count (Dr. M. R. Kark): R.B.C. 4,200,000; Hb. 85%; W.B.C. 5,000. (*Differential*: Polys. 31%; eosinos. 0·5%; basos. 1·5%; lymphos. 65%; hyals. 2%; reticulos. 0·4%). Platelets 210,000. No myelocytes, myeloblasts, or lymphoblasts seen.

Report on section of gland removed from neck (Prof. P. W. de C. Nicholson): "A lymphosarcoma, if not contra-indicated by blood-count."

POSTSCRIPT (25.7.38).—The cervical glands have decreased very considerably in size under deep X-ray therapy, but the child is now complaining of dysphagia and his general condition has deteriorated. The size of the spleen remains unchanged.

Klippel-Feil Syndrome.—S. MACKENZIE, M.R.C.S., L.R.C.P. (for Dr. K. H. TALLERMAN).

T. L., male, aged 7 weeks.

18.5.38: Admitted to hospital on account of failure to thrive.

History.—Said to have been born prematurely by about three weeks. Mother a primigravida, aged 33, married for twelve years. Labour rather rapid, lasting only ten hours (mostly first stage). Vertex presentation. No instruments used. On the third day, while being suckled, the baby suddenly became blue. Next day the mother noticed that the right arm was paralysed, with deformity of the right hand. The child was too weak to suck properly until four weeks old, and had frequent

attacks of cyanosis and dyspnoea, not always or only while sucking. Breast-feeding has been continued, but the baby has never thrived and has always sucked very badly. Birth-weight 5 lb. 5 oz.; weight on admission 4 lb. 8 oz.

The mother had been told that the child had suffered from a cerebral haemorrhage.

Family history.—Nothing of significance.

On examination.—Small wizened baby with feeble cry. Cyanosis constantly present. Gross wasting but no dehydration. Thick growth of hair extending down to the neck, which is short; the head is tilted upwards and backwards. Occipital



FIG. 1.—Showing web-neck and torticollis.

prominence with spur of bone palpable at mid-line posteriorly. Cervical spines and dorsal spines not felt. Kyphoscoliosis of upper dorsal column, with convexity to right. Both scapulae winged. Bilateral web-neck, with limitation of head movements (fig. 1). Torticollis to right. Hypognathous pointed chin. Slight facial asymmetry. Bulging of ribs on right side. Measurements: Head circumference 13½ in.; shoulders 12½ in.; length 19½ in. Spastic paralysis of right arm with hand in *main en griffe* position. The fingers can be moved voluntarily. Slight spasticity of other limbs with left *main en griffe*, and bilateral talipes calcaneovarus. No lanugo. No mal-development of nails. No mirror movements or ocular palsies. No evidence of congenital morbus cordis, or any other lesions.

Cerebrospinal fluid : Clear and colourless with no deposit. 6 lymphocytes per c.mm. No other cells. Protein : 40 mgm. per 100 c.c. Wassermann reaction negative.



FIG. 2.—Showing cervical-spine deformity.

X-ray examination : Failure of fusion of D. 1-4, and C. 4-7 (as far as can be made out), with a gap between each half of these bodies and consequent widening of the spine. (See fig. 2, illustrating cervical-spine deformity.)

25.5.38 : Since admission to hospital the infant has been breast-fed, with small complementary feeds, has progressed satisfactorily, and has gained 4 oz. in weight.

Cerebral Tuberculoma. — R. H. BAILEY, M.B., B.Chr. (for WILFRID SHELDON, M.D.).

A. J. R., a boy, aged $7\frac{1}{2}$ years, has had epileptiform attacks for three years past. He now has five or six attacks daily, though earlier he had only one attack in a day. He knows when an attack is coming on because he feels giddy. The attack begins with a tonic spasm, followed by a clonic spasm and an epileptic cry. There is no

cyanosis but the child loses consciousness. There are no definite localizing signs, although the left arm is said to go up just before the attack. Any excitement brings on an attack.

Past history.—Has had scarlet fever, whooping-cough, measles, and tonsillitis.

Family history.—No fits on the father's or mother's side. No miscarriages. The patient is an only child.

On examination.—Slightly dull mentally, probably owing to treatment by luminal and bromides. Does not co-operate very well. Cranial nerves : Pupils react to light and accommodation ; no abnormality discovered.



FIG. 1.—Antero-posterior view of skull.

Reflexes : Biceps, triceps, abdominals, knee-jerks and ankle-jerks—all present, though very sluggish ; plantars indefinite ; sometimes extensor and sometimes flexor.

He has had several attacks since admission but no definite localizing sign has been discovered.

That the obscure mass in the skull was a tuberculoma, was made relatively certain by routine X-ray examination of the chest and abdomen.

Investigations.—Lumbar puncture : Cells 2 per c.mm. ; protein 40 per 100 c.c. ; globulin test negative ; chlorides 722 mgm. per 100 c.c. ; sugar normal. Wassermann reaction negative. Lange gold test 0000000000.

Mantoux test (1 : 1,000) : Reaction strongly positive.

X-ray examination of skull (3.5.38) : "There is a calcified area within the left hemisphere in the posterior parietal region. This is suggestive of a tuberculoma" (figs. 1 and 2).



FIG. 2.—Lateral view of skull.



FIG. 3.—Showing calcified tuberculous glands over the right sacro-iliac joint.

X-ray examination of chest and abdomen: "There is a mass of calcified glands over the right sacro-iliac joint (fig. 3). There is no evidence of pulmonary disease."

A Type of Osseous Dystrophy affecting the Hands and Feet.—C. HARDWICK, M.R.C.P. (by permission of DONALD PATERSON, M.D.).

L. N., a girl aged 6 years and 10 months, was seen at the Hospital for Sick Children, Great Ormond Street, in February 1938. The mother said that one year previously the joints of the fingers had appeared to be swollen. This condition has progressed.

The patient is the sixth child of healthy, unrelated parents. The brothers and sisters are all healthy; none have any similar abnormality, and there is no history of any similar trouble in the family.



FIG. 1.

Condition on examination.—A small thin girl, height 39 in. (standard 45 in.) ; weight 31 lb. (standard 48 lb.). There is swelling of the heads of the middle phalanges of both hands and feet, more noticeably in the hands (fig. 1). There is no pain or limitation of movement, and no other joints are affected. No abnormality in any other systems was found on physical examination.

Wassermann and Kahn reactions are negative in both mother and child. Mantoux reaction (1 : 1,000) negative. Sedimentation rate 6 mm. in 1 hr. (normal). Skiagrams of chest, spine, and skull, normal.

Skiagrams of the fingers and feet show the middle and proximal phalanges to be short and broadened, particularly at their heads (fig. 2).



FIG: 2.

Dr. PARKES WEBER said that the fingers in this case superficially resembled the "osteoarthritic" fingers not rarely seen in old persons. Dr. Richard Armstrong had described a somewhat similar condition in children under the heading "Family Osteo-arthritis" many years ago (*Proc. Roy. Soc. Med.*, 1919-1920, **13**, Sect. Dis. in Child., 24), and in the discussion he, Dr. Weber, had suggested the term "Thursfield's and Armstrong's familial *osteo-arthritis-like deformity of fingers*".

Section of Dermatology

President—H. HALDIN-DAVIS, F.R.C.S.

[May 19, 1938]

Two Cases of Atrophic Lichen Planus in Women.—H. MACCORMAC, C.B.E., M.D.

I.—Mrs. C. S. E. B., aged 55, was seen privately on March 24, 1938. She is under treatment for diabetes and for the last thirteen years has injected insulin, usually in the right thigh. Five years ago she observed white spots developing under the right clavicle, and last year similar white spots began to appear on the right thigh, which the patient attributes to the needle-prick of the insulin syringe. There are now a number of small atrophic lesions in this region and marks of the needle-prick, which will probably undergo similar degenerative changes. She has also lichen planus of the vulva.

II.—Five years ago, Mrs. C. H., aged 62, observed a white appearance of the vulva with intense itching. About nine months ago large patches of superficial atrophy developed on the outer surfaces of the forearms, and recently atrophic white spots have appeared high up on the inner thighs. There is a plaque of lichen surrounding the anal orifice which does not itch, and as Dr. Kleeberg, who made the examination, informs me, the lichen extends on to the rectal mucosa. There is also lichen on the buccal mucous membrane, just inside the labial commissures, and one slightly raised papule on the right wrist undergoing a sclerotic change.

Comment.—These two patients exhibit the characteristic appearances of so-called atrophic lichen planus with pruritus vulvæ. They have been shown because they are examples of a condition which it is held in some quarters should be labelled lichen sclerosus, and taken out of the lichen planus group. It may be pointed out that the distribution in both cases is characteristic of lichen planus as commonly recognized, and that in the second case there are typical lesions on the buccal and rectal mucosa and a papule on the wrist. Dr. Barber showed at the May meeting of the Section in 1931 (*Proceedings*, 24, 1356, Sect. Derm., 66) a patient in whom the papules were undergoing an atrophic change with an accompanying, if slight, degree of lichen spinulosus. The effect of trauma, for example a scratch from a pin, in causing the development of fresh lichen papules is well known, and this phenomenon led Jacquet to believe that the eruption was always the result of scratching. In the first case a reaction to slight trauma—the insulin needle—is well displayed, and although the consequences are atrophic rather than papular, in this reaction to injury the skin behaves exactly as in the accepted forms of lichen planus.

Discussion.—Dr. A. D. K. PETERS asked for Dr. MacCormac's views on the relationship of lichen planus atrophicus to leukoplakia vulvæ. Professor Amy Fleming and she (Dr. Peters) had been investigating a series of vulval lesions from a combined gynaecological and dermatological point of view. They had found evidence of lichen planus in comparatively few cases. At present they had found that cases with the clinical and histological picture of leukoplakia were associated with ovarian hypofunction, and had responded in great measure, while not entirely, to oestrin therapy.

Dr. ELIZABETH HUNT said that since she had published a paper in which she had described a number of similar cases, she had been collecting others, and had been able to obtain a number of sections which had been examined by Dr. Freudenthal who had so far been able to confirm her diagnosis of lichen sclerosus. The majority of these cases had been referred to her by gynaecologists who had found no evidence of any gynaecological complication. The two cases shown that afternoon she would have described as typical lichen sclerosus of the vulva.

Since the publication of her paper she had met with two cases of lichen sclerosus of the vulva in which, later, cancer had developed. She had obtained sections from different sites on the vulva in one of these cases and hoped to publish full details shortly. The second had

probably been an example of Bowen's disease. There had been a small red plaque on the inner surface of the vulva; no evidence of glandular involvement had been found. The patient had disappeared for six months, during which she had travelled extensively and had suffered little discomfort. At the end of that time acute symptoms had suddenly developed and on examination a huge carcinomatous growth had been found ulcerating and infiltrating towards the rectum and involving the inguinal glands.

Dr. MACCORMAC (in reply) said that the point with regard to the liability to malignant change raised by Dr. Hunt was an interesting one. Everyone would agree that lichen planus on the buccal mucous membrane was a most rebellious condition, and yet it was by no means liable to malignant degeneration. The apparently similar eruptive process on the female genitalia was thus quite different—since, in Dr. Hunt's view, it was liable to initiate a carcinoma.

Benign Lymphogranulomatosis (Schaumann).—H. SEMON, M.D.

The patient is a married woman aged 42. The patches on the arms were first noticed sixteen years ago, and occurred a year after enucleation of the right eye on account of iritis, the cause not being specified on application to the hospital, the report from which is as follows:—

"This patient was admitted to the Royal London Ophthalmic Hospital, October 22, 1919, on account of a severe kerato-iritis of the right eye. The cornea was scarred and vascularized and the iris atrophic, with complete ring synechia causing iris bombe. The pupil was blocked with dense exudate. The vision was only hand movements. The left eye was normal."

On October 21 an iridectomy was performed on the right eye and the patient discharged a fortnight later.

Unfortunately, pain in the eye persisted and she was readmitted, and excision of the right eye was performed on December 30. The Wassermann reaction was negative." [Harold Ridley.]

She gave no history of tuberculosis in her family or in her own case, and the Mantoux and Wassermann reactions are negative.

Histological sections of one of the patches on the left forearm revealed characteristic nests of epithelioid cells in the subcutaneous tissue, and are so typical as to leave no doubt as to the diagnosis of lymphogranulomatosis benigna.

Her only complaint is of slight rheumatism, and it will be noticed that two fingers of the right hand are swollen at their roots in a spindle-shaped manner (*spina ventosa*), and on X-ray examination show evidence of osteoporosis. The radiograms of the lung reveal abnormalities similar to those described by Schaumann in his last paper on the subject, *Brit. Journ. Derm.*, 1936, 48, 398-446.

I do not think there can be any doubt as to the nature of this case. I first saw the patient at the Royal Northern Hospital in March of this year, and she complained only of the bluish patches on her forearms and upper arms, which, she stated, had been present for sixteen years without causing any sort of subjective sensation. The reason for that is obvious when one looks at the microscopic section, which is totally devoid of any reactive phenomenon.

Another interesting point in this case is the history of loss of an eye, which occurred one year previous to the onset of the skin manifestations.

I think one should take notice of such ocular manifestations in the course of benign lymphogranulomatosis. Dr. Schaumann published a case in which a similar complication had occurred,¹ and Dr. Hugh Gordon showed another at a meeting here last year.² I think there must be a common cause. It is more than a coincidence to see three cases (and others have, I think, been reported) of lymphogranulomatosis in which such serious ocular association has occurred.

I submitted a picture of the lung to a tuberculosis expert, but he could not give me a definite diagnosis. I fear he had never heard of benign lymphogranulomatosis, but he said there was "congestion," and negative tuberculosis. There is something about that picture which we would all admit to be pathological, but to make a

¹ *Brit. Journ. Derm. and Syph.*, 1936, 48, 402.

² *Proceedings*, 1937, 30, 1057 (See *Journ. Derm.*, 69); *Brit. Journ. Derm. and Syph.*, 1937, 49, 391.

diagnosis of benign lymphogranulomatosis on this radiogram alone would be, I think, impossible.

Radiograms of the hand showed slight absorptive changes in the proximal phalanges of the index finger of the right hand.

I have been following Dr. Gray's suggestion as to treatment with sodium morrhuate. I should like details as to whether his treatment has been successful, and as to what strength he uses, and what interval of time elapses between the injections.

Discussion.—Dr. F. PARKES WEBER commented upon the interest of the history of severe iritis or, as the description rather suggested, iridocyclitis, for which the patient's eye had been removed. Lately there had been papers suggesting that the cases classed as Heerfordt's uveo-parotid syndrome were really varieties of Schaumann's benign lymphogranulomatosis. The question of the nature of the lung changes in benign lymphogranulomatosis was also being much discussed.

Dr. A. M. H. Gray (in reply to Dr. Semon's question as to treatment) said that he did not see a great number of the cases. In very mild cases the lesions, as a rule, disappeared under treatment with sodium morrhuate, and did not return. In the more severe cases the lesions subsided to an extraordinary degree, but there was a tendency for them to recur when treatment ceased. Of two particularly severe cases which he had had under treatment one had been an extreme case of lupus pernio, with facial lesions and also lesions like those on the arms in Dr. Semon's case, only much more marked, including a great amount of subcutaneous thickening. Several fingers had been intensely swollen and purple and had shown definite changes in the bone; there had also been similar lesions on the feet and legs. In that case the cutaneous lesions had practically disappeared—leaving behind a certain amount of atrophy, and certain definite changes for good had taken place in the bones. The radiograms afterwards showed definite consolidation of bones. The patient, however, eventually developed pulmonary tuberculosis.

In the other case there had been few skin lesions. Atrophic lesions on the face had been associated with a large spleen and a persistent temperature of about 101° F. The effect of sodium morrhuate given in that case had been to bring down the temperature at once, and as long as the patient had been under treatment the temperature had remained normal, and the spleen had become very much reduced in size. On cessation of treatment the spleen had gradually enlarged again. The temperature had begun to rise but re-administration of sodium morrhuate had again brought it down.

With regard to dosage: He gave a 3% solution either intravenously or intramuscularly, usually beginning with a small dose (1 c.c.) once a week and then increasing to 2 c.c. once a week. Sometimes he gave as much as 2 c.c. twice a week, but patients then, as a rule, became uncomfortable. About 2 c.c. once a week was all that could usually be easily tolerated. One could of course split the dose and give 1 c.c. twice a week. He used an aqueous solution which he thought was quite safe.

Dr. HUGH GORDON said he had had a severe case under observation for five years, in which there were lesions in the skin, bones, and lungs. Sodium morrhuate, which had been given a thorough trial, and many other methods of treatment had all been without effect.

Dr. GRAY said that quite a number of cases failed to respond to the sodium morrhuate treatment. He himself had seen one such case.

Dr. SEMON (in reply) said that he had been giving five injections but he was not at present convinced that there was any change. He would, however, continue the injections.

Cutis Verticis Gyrata (Congenital).—SYDNEY THOMSON, M.D.

A boy, aged 14 months, brought to hospital on account of eczema of forehead. The typical lesion on the vertex was then noticed. This is now of the size of a shilling. It is definitely stated by the mother that it was present at birth and that it has not grown in size at all, even in proportion to the growth of the child. No relevant history was discovered in the family. Excision will be carried out later.

The only point in showing this case of cutis verticis gyrata is that the congenital form seems to be extraordinarily rare. I believe this is only the third case which has been shown at a meeting of this Section since the Great War. The best example

was shown in 1931, by Dr. W. P. Grieve and Dr. E. Biddle—introduced by Dr. Roxburgh—a case in which the patient had reached adult years; he was then aged 20 and had lesions measuring about 3 in. in diameter.³

Dr. PARKES WEBER said he thought that this small “cutis verticis gyrata,” which was obviously of the nature of a nevus, in the broad sense of the term, might be explained as similar to ordinary moles on other parts of the body, but modified by the presence of coarse scalp hair follicles, to which it owed its peculiar appearance. The cutis verticis gyrata, which occurred in some cases of acromegaly, was doubtless of totally different nature (*see* F. P. Weber, *Brit. Journ. Derm. and Syph.*, 1928, **40**, 1)—an exceptional manifestation of the endocrine action of eosinophilic pituitary hormone.

Leiomyomas.—SYDNEY THOMSON, M.D.

A woman, aged 56 years. The lesions first appeared on the arms about thirty years ago, those on the face and trunk becoming evident later. There are now about 66 lesions on the right arm, 38 on the left, 25 on the face, and some 17 on the trunk. Exact enumeration is difficult owing to coalescence of some of the nodules. Most of the lesions are typical in colour, size, shape, &c., and scattered between these are numerous small colourless intradermal nodules which appear to be very early leiomyomas. Pain has been slow in making its appearance, only being at all marked during the last three years. It arises when the patient moves from a warm into a colder atmosphere, and the intensity of the pain appears to be proportionate to the intensity of the cold. It is said that the colour of the tumours is considerably decreased during this phase, but that it returns when the patches are rubbed vigorously. The pain then disappears and remains absent for several hours, for which reason the patient adopts this simple treatment herself whenever necessary. The lesions are somewhat painful when touched and the normal skin in the neighbourhood appears to be hyperesthetic.

“Gravel”, and “pus in the urine” occurred about the time the first lesions were noticed, and lasted for eighteen months. Hysterectomy had been performed for fibroids in 1921, mucous colitis was present in 1926, and extrasystoles have been present for the last three years. There is no history of numerous hypodermic injections into the arms. The patient herself is somewhat introspective, and it may be noted that her eyes differ in colour, the right being light brown and the left a grey-blue.

Nothing relevant was discovered in the family history.

? Sarcoma of the Skin.—A. M. H. GRAY, C.B.E., M.D.

F. J. R., male, now aged 55, was shown at the meeting held in June 1927⁴ having a curious ringed eruption on the left thigh. The eruption had begun two years previously and, at the time he was shown, consisted of an oval area, some 9 in. by 5 in., the centre being pigmented and atrophic, surrounded by an infiltrated margin $\frac{1}{2}$ in. to $\frac{3}{4}$ in. in width, raised considerably from the skin surface and of a dull red colour. This margin was not entirely continuous but showed gaps in places. Two smaller lesions of a similar character were present on the same thigh, and there were one or two slightly infiltrated erythematous patches in the neighbourhood of the larger lesion. The Wassermann reaction was negative and there was no clinical evidence of syphilis.

The histological appearance of a section was peculiar, mainly owing to the presence of large numbers of giant cells scattered irregularly through the dermis. Dr. Freudenthal has recently examined the sections taken at that time and reports as follows:—

“The epidermis shows only slight changes, consisting of a few small areas of parakeratosis and irregularity in depth of the prickle-cell layer, which shows a trace of spongiosis in places. The rete pegs have disappeared in some areas. These changes are slight and apparently secondary.”

³ *Proceedings*, 1931, **24**, 1011 (Sect. Derm., 48).

⁴ *Proceedings*, **20**, 1834 (Sect. Derm., 114).

The dermis, on the other hand, is markedly changed. It shows a particular type of granulation-tissue, which occupies large areas of the dermis and extends into the connective tissue septa between the fat lobules. The granulation tissue consists of giant cells and epithelioid cells. The giant cells are round, oval, lanceolate, or somewhat angular in shape. The protoplasm is homogeneous or finely granular, and shows occasional vacuoles and sometimes an ill-defined, irregular edge. The nuclei number from two to fifteen or more, are round or oval and in most cells are arranged at the periphery, frequently being aggregated at one or opposite poles of the cell. For the most part the giant cells are scattered singly and irregularly throughout the cutis, but some tendency to group formation is present in places, either as an arrangement in strands or a loose aggregation. It is only in the enlarged interlobular septa that an attempt at nodule formation may be seen. The epithelioid cells are scantily distributed throughout the cutis, only in the interlobular septa they are present in increased number amongst the giant cells.

There is some inflammatory reaction, consisting of lymphocytes and plasma cells, partly arranged around small newly formed vessels, partly as oblique strands of densely packed cells.

The connective tissue cells are increased throughout and fibroblasts may be seen. At some places the collagen bundles have undergone a degenerative change: they have lost their regular structure and stain brownish-yellow with van Gieson. In these places the elastic tissue has disappeared, in other places throughout the cutis it is greatly diminished, only in the flattened-out papillary body is it more or less normal; there the collagen tissue shows slighter changes than elsewhere."

I thought at the time that the case was one of persistent erythema multiforme of unusual type, possibly related to Crocker's erythema elevatum diutinum, but in the discussion Dr. Dore expressed the view that it might be a case of mycosis fungoïdes. I had the opportunity of showing the case later to the late Professor Jadassohn, when he was on a visit to this country. He was frankly puzzled and thought it might be a case of Darier-Roussy sarcoid.

The lesions were treated with X-rays and disappeared rapidly, but a few more appeared on the same thigh in 1929 and 1930, and these again disappeared under X-ray treatment. No further prominent lesions have appeared till the last few months, though some faint flat erythematous patches have persisted. Recently a tumour, having the same appearance as the original lesions, but as yet showing no signs of clearing in the centre, has appeared on the left buttock, just behind the great trochanter. It is about 5 in. by 3 in. in diameter and very hard to the touch. In addition, for the first time, two hard glands have appeared in the left groin. The blood-count shows nothing abnormal. Sections have been made, and Dr. Freudenthal reports on them as follows:—

"Two pieces of skin from the left thigh were removed (a) from the large tumour (b) from a hook-shaped lesion and (c) from an enlarged gland in the left groin.

In (a) the entire cutis, with the exception of a narrow sub-epidermal strip, is the site of a dense infiltration. Most of the cells are round or oval-shaped; some also spindle-shaped. They are either arranged in strands, or in smaller or larger ill-defined irregularly shaped masses or lying between the bundles of the collagen tissues, which by the infiltration is rather more displaced and broken than actually destroyed. The elastic tissue, although diminished, is preserved in many places and some elastic fibres are to be seen running through the infiltration. A very few isolated giant cells of the Langhans' type were detected.

In (b) the infiltration is less extensive, consists of the same elements (except giant cells) and shows a very marked perivascular arrangement. The structure of the lymph-gland (c) is destroyed and a dense infiltration is found of the same kind as in the skin."

The microscopic appearances now suggest a sarcoma, though it is not possible entirely to rule out mycosis fungoïdes. Two similar cases are pictured in Jadassohn's "Handbuch".

Discussion.—Dr. SEMON said that some years ago he had had a similar case which at the time he had diagnosed as one of sarcoma. When the patient was first seen the growth had been present some seven or eight years on the front of the right chest, and the sections were diagnosed as being sarcomatous in nature. At first the growth had responded extremely well to X-rays, and had practically cleared up. The patient, however, had returned a year or two

later, presenting same picture as that shown in Dr. Gray's case. Eventually nodules had developed, but they did not spread beyond the original area involved. Subsequently the patient had developed lung symptoms and chronic pleurisy on the right side. At the post-mortem examination similar infiltrations had been found in the lung.

Dr. H. W. BARBER said that he had recently seen an elderly person who had a nodule on his back, about the size of a walnut, surrounded by circinate lesions exactly similar to those in Dr. Gray's case. Dr. Muende, who had examined a section from the tumour had thought—and he (the speaker) had agreed with him—that the case was probably one of mycosis fungoides. The original nodule had been treated with radium and, for a time, had subsided, and at the same time the circinate lesions had disappeared, but very severe pain had developed in the left leg. The patient had then been seen by Dr. C. P. Symonds, and the question arose as to whether that pain was due to a secondary deposit. The nodule had been treated with radium several times and had ulcerated. Eventually the patient had died. He (Dr. Barber) had since wondered whether his diagnosis had been wrong, and the case had been one of sarcoma. The interest to him was the presence of the circinate lesions.

The PRESIDENT said that he had seen a similar case many years ago, but unfortunately had not had an opportunity to investigate it thoroughly. There had been circinate lesions on one leg only, similar to those in Dr. Gray's case. He had regarded it as a case of mycosis fungoides curiously limited to one limb. The lesions had all disappeared after treatment with X-rays.

Dr. GOLDSMITH asked whether in any of the cases mentioned, the lesions, or any part of them, had cleared spontaneously without irradiation. When Dr. Gray's case had first been under observation, the ring had collapsed completely in some parts, without treatment. That was perhaps of importance in considering the question of sarcoma. He did not know to what extent it was accepted that sarcoma could vanish rather suddenly, as it was known that mycosis could do.

Dr. BARBER said that in his case the radium had been applied only to the tumour, not to the circinate lesions; nevertheless they had disappeared.

Dr. GRAY said that the ring was very nearly 9 in. across, and all the centre had cleared up spontaneously without any treatment whatever. The strong point against the case being one of mycosis fungoides seemed to be the absence of any tendency to ulcerate.

Dr. MACCORMAC said that in the course of a discussion on mycosis fungoides held by the Section in 1914⁵ he had reported the presence of definite giant cells in one of the three cases whose histology he had been studying.

Urticaria Pigmentosa.—A. M. H. GRAY, C.B.E., M.D.

A. W., a boy aged 8, was shown at a meeting in 1930, but no record of the case has been published. The child was apparently quite normal till 7 weeks old, and then a purplish patch appeared on the dorsum of the right foot and a few days later another on one hand; then suddenly the skin over the whole body was thrown into folds. Blood-stained blisters were also said to have occurred. When seen at that time, the skin over the whole body was of a curious yellowish or fawn colour, and was much thickened. Pea-sized hard nodules occurred everywhere and were more or less confluent. The skin when rubbed became reddened, and wheals were easily produced by friction. No biopsy was made at the time but a diagnosis of urticaria papulosa was made.

I did not see the boy again till about three months ago. The condition still persists though the nodules are not so prominent as previously. The lymphatic glands are, however, markedly enlarged and the skin still shows factitious urticaria. Sections have been examined from the skin and glands by Dr. Freudenthal, who reports as follows:—

"Pieces of skin were removed from the chest and from the abdomen; also an enlarged gland from the right groin. Fixation in sublimate acetic acid, alcohol abs., and 10% formal-saline.

Epidermis.—The rete pegs are flattened out in many places, otherwise no change.

Cutis.—In the upper half of the cutis the collagen tissue is replaced by a very densely packed infiltration consisting almost entirely of mast cells mixed up with a few fibroblasts

and eosinophils. Towards the epidermis this dense infiltration is sharply demarcated and leaves a narrow subepidermal strip comparatively free. In the lower half of the cutis the infiltration is less dense and arranged mostly in horizontal streaks and along smallest vessels.

Subcutaneous tissue.—Mast cells are also found in the meshes of some of the subcutaneous fat lobules.

Gland.—There is a certain degree of lymphatic obstruction and sinus fibrosis, but the structure in general is fairly well maintained. A good number of mast cells are scattered over the gland, more especially in the reticular tissue. Numerous mast cells are seen in the fibrous capsule of the gland."

The microscopical appearances, therefore, confirm the diagnosis of urticaria pigmentosa and, as far as I am aware, show for the first time evidence of involvement of the glands in this condition.

Blood-count : R.B.C. 5,320,000 ; Hb. 92% ; C.I. 0.87 ; W.B.C. 6,700. (Differential : Polys. 52% ; lymphos. 41% ; eosinos. 7% ; basos. 0%).

Discussion.—Dr. PARKES WEBER said that he remembered seeing the case when Dr. Gray had shown it in 1930. What had happened, so far as he could see, was that the urticaria had now become generalized and confluent urticaria pigmentosa. He did not think that such a confluent urticaria pigmentosa had ever previously been described.

Dr. W. FREUDENTHAL : Attention was first drawn to the enlargement of lymph-glands in urticaria pigmentosa by Sir Ernest Graham Little in 1905. In his comprehensive paper, however, no mention is made of any histological investigations of a gland. Neither FINNERUD (1928) nor HANNEY (1925) in their recent surveys, nor TÖRÖK, in Jadassohn's Handbook report of any lymph-glands being investigated.

How far the amount of mast cells seen in this gland might be regarded as peculiar to urticaria pigmentosa we cannot say at present. Mast cells occur in normal lymph-glands (Lehner, 1924) and in pathological lymph-glands, but no comparative study has yet been undertaken in order to find how far their number varies under normal and under pathological conditions. In the capsule of the gland, however, mast cells were found so closely aggregated in some areas that one must be inclined to regard them as abnormal.

References.—GRAHAM LITTLE, E. (1905), *Brit. J. Dermat.*, **17**, 355. FINNERUD, C. W. (1928), *Arch. Dermat. and Syph.*, **8**, 344. HANNEY, M. G. (1925), *Brit. J. Dermat.*, **37**, 1. LEHNER, JOSEF (1924), *Ergebn. d. Anat. u. Entwicklungs gesch.*, **25**, 67-184.

Dr. I. MUENDE said that he had examined polychrome methylene-blue sections of lymphatic glands in normal individuals, and glands affected by tuberculosis and Hodgkin's disease, and also some containing secondary deposits of carcinoma. In all these cases there were a few typical mast cells in the capsule but none within the gland. He was not convinced that the cells in the section under consideration were true mast cells.

Acneiform Eruption in a Child.—A. M. H. GRAY, C.B.E., M.D.

C. H., a male child, was first seen by me in September 1935, when just 2 years old, on account of reddish indurated papules on the cheeks and a fluctuating swelling, about half an inch in diameter, below the left eye. During the next eighteen months other deep-seated nodules, eventually developing into cystic swellings, appeared on both cheeks. I suspected that the lesions might be tuberculous and had smears examined and cultures made from the fluid in these swellings. Reports showed that numerous polymorphonuclear leucocytes were present, but no organism could be seen in the smears and the cultures were sterile. The child was admitted to University College Hospital for observation under Dr. Pearson, but clinical and radiographic examination proved negative. The Mantoux test was also negative.

Pathological report (Dr. Freudenthal) : "A biopsy from the face shows a sharply defined nodular infiltration in the deeper part of the cutis. It consists mainly of lymphocytes, also fibroblasts and a few plasma cells, not very densely packed and without forming tuberculoid tissue."

For the last year or so the lesions have shown a tendency to clear up; the only local treatment has been the application of olate of mercury ointment, but the child has spent much of his time in the open air.

The clinical appearances resemble ordinary nodular acne very closely. They differ from common acneiform lesions seen in children in the depth of the lesions and

the absence of comedones, and there is no evidence of oil having played a part in the production of the lesions. I am at a loss to suggest the aetiology.

Discussion.—Dr. I. MUENDE said that about a year ago, when investigating 110 cases of chlorine acne, he had found this condition in a baby aged 1 year and 10 months, whose mother had typical chlorine acne.

Dr. R. KLABER said that he had seen a similar pustular acne in a breast-fed infant aged 6 months. Cultures had proved sterile, and injections of the pus into a guinea-pig had produced no specific changes. Inquiries into the question of drugs elicited the fact that the child had been taking Winslow's "Soothing Syrup", but neither this preparation nor the child's urine was found to contain any bromides. The mother herself had not knowingly taken any bromide or iodide mixture. The father was in the habit of taking Clarke's "Blood-Mixture", but there was no reason to suppose that this could affect the child!

Dr. GRAY (in reply) said he did not think the case was one of drug absorption, or one that could be attributed to the mother's milk; the child was aged 4 years, and he thought that in the latter case the acne would have disappeared by now! It was unusual either in chlorine or bromide acne to get such deep-seated cystic lesions; the lesions were generally of a superficial type. The late Dr. Wallace Beattie had described a case of acne in an infant, which he thought was due not to oil or drugs but to the acne bacillus itself.

Rosaceous Tuberculide.—GODFREY BAMBER, M.D.

Mrs. M. S., aged 46.

History.—About six months ago her face "went red" and a rash appeared under the skin. The rash has spread, and she suffers from indigestion and flushing of the face.

On examination.—Numerous miliary- to lentil-sized papules are scattered over the face and neck. On diascopy the papules showed a slight yellowish stain.

A diagnosis of rosaceous tuberculide was made, but in view of the definite history of rosacea, it was decided to see what effect treatment for this would have on the eruption. Although the digestion improved and the flushing became less, the papules became more numerous, so she was given injections of lopion. Already after a few injections there is a definite improvement as regards the papular eruption.

A biopsy of a lesion on the neck showed an arrangement of epithelioid and giant cells.

Discussion.—Dr. SYDNEY THOMSON said that he had had a case of apparently definite rosacea in which the patient had done very well on appropriate treatment with hydrochloric acid, &c., and the eruption had almost entirely cleared up. She had then gone to Brighton, and soon afterwards had seen Dr. Twiston Davies who had agreed with the diagnosis. The condition became worse, and when she again saw Dr. Davies, some three months later, he had definitely diagnosed rosaceous tuberculide. Two months afterwards the patient returned to town and again came under direct observation. There was now a sheet of typical lupus vulgaris over the whole of the face.

Dr. W. N. GOLDSMITH said that he had a case of rosaceous tuberculide in the ward at present. When he had first seen the eruption he had made this diagnosis, especially as the front of the neck was involved. As a result of very close questioning, and putting almost leading questions, he could not make the patient admit that she ever noticed any flushing. The histology was rather like that of lupus vulgaris. Since the patient had come into hospital the eruption had subsided a great deal and most of those who had seen her had wondered why he had diagnosed rosaceous tuberculide and thought it was rosacea. He had just carried out a contrast Moro test as follows: As controls, two surface applications of tuberculin ointment were made, one over the lesions and one over normal skin. Two applications of ointment having the same base, but without tuberculin, were made over some lesions and also over the normal skin. Of the four applications, all of which were on the face or neck, only one produced any inflammatory reaction, namely that of the tuberculin ointment over the lesions, and that was conspicuous. He thought that circumstance was in favour of a tuberculous aetiology. He would be interested to hear if a similar test had produced a positive reaction in the case under discussion. The presence of a positive Mantoux reaction at some distance from the lesions did not help one very much in the diagnosis.

Dr. BAMBER said that he had carried out a Mantoux test in this case and as the eruption was somewhat sensitive he had begun with 1 : 1,000,000 dilution; the result had been negative. He had not yet gone down to the other dilutions.

Darier's Disease.—HUGH GORDON, M.C., M.R.C.P.

The patient, a married woman, aged 32, first noticed the eruption at the age of 7. It has since spread progressively over the body.

Present condition.—The scalp is crusted and purulent, and the glands of the neck are swollen. The face shows some horny plugs round the nose but it is otherwise clear. The trunk is pigmented; there is a sheet of keratosis on the interscapular area and abdomen, typical of Darier's disease. There are some scattered lesions on the thighs; below the knees the lesions are confluent. A section taken from the abdomen showed the histological changes characteristic of Darier's disease.

The chief interest of the case, beside that of being a good example of a comparatively rare condition, is that it illustrates how in this disease repeated exacerbations and remissions may occur. Subjective symptoms, too, are well marked. The patient remembers that at the age of 7 an acute exacerbative process occurred round the ears and the margin of the scalp. This apparently disappeared completely, and her skin was clear until the age of 14. She then had an acute attack affecting the whole body, heralded by burning sensations and itching. This acute phase lasted three months; she recovered somewhat, but the skin has not been normal since. Since then she has had three major attacks of eruption on the scalp, while that on the body has fluctuated. There is no sweating over the whole body, and she is considerably better in winter than in summer. She says that in winter she can wear thin silk stockings without the roughened skin showing through. During three pregnancies the skin became nearly normal.

The patient was first seen by me two months ago, when there was an acute exacerbation. The scalp was covered with a thick purulent crust, the temperature was raised, and over the body there was an extensive keratosis—in some places crusted.

Treatment on secondary lines was instituted for the scalp, a sulphur and salicylic ointment was ordered for the body, and oestroform (3,000 units) was given weekly. Within three weeks the eruption on the scalp had completely disappeared, leaving a pink and apparently normal skin; the body similarly improved enormously. The scalp is said to have relapsed somewhat during the last three days.

I am not certain how common this ebb-and-flow is in Darier's disease. In two other cases which I have observed, purulent exacerbations have taken place. When these have subsided, however, the underlying keratosis has remained unaltered.

Dr. PETERS asked Dr. Gordon if the condition of the patient's whole skin had improved as well as the affected areas. After the use of oestrin for various dermatological conditions she had noticed that the skin became more supple and apparently thicker, and that the complexion became paler and more translucent, the patients looking younger in consequence.

She thought it important to differentiate between this trophic non-specific action and a possible specific action exerted against a morbid process. Naturally many dermatological conditions would be benefited by the former and it might be difficult to assess therapeutic results in consequence.

Lipophagous Granuloma (Telford).—LOUIS FORMAN, M.D.

The patient is a woman aged 51.

The lesion was first noticed on the front of the left shin twenty months ago, and has slowly extended backwards to the calf. At the front there was a crescentic, cyanotic infiltration involving the skin and subcutaneous tissue. The legs were cold and blue.

Previous history.—Three years ago the uterus was removed on account of carcinoma.

The position of the granulomatous reaction on the calf, with the poor circulation of the skin and subcutaneous tissue, suggested the diagnosis of lipophagous granuloma (Telford, *Arch. Dermat. and Syph.*, 1937, **36**, 952). The essential feature of the pathology of the lesion is injury to the fat of the subcutaneous tissue by either cold, ischaemia or toxins. The surrounding granuloma is replaced by fibrous tissue. This may help to explain these cases of nodules of the legs in middle-aged women with

poor peripheral circulation, in which one can find no tuberculous or other bacterial aetiology.

Microscopical report (Dr. Muende): In the corium there is a cellular infiltration both around the blood-vessels and also scattered between the collagen bundles. In the former region they are composed chiefly of lymphoid cells, though there are a few plasma cells and several epithelioid cells. Among the bundles they are chiefly large fixed connective-tissue cells. In the subcutaneous tissue there are large fibrotic zones in which there are epithelioid cells and large multinuclear giant cells. At the periphery of these zones there are numerous closely packed polyhedral foam cells which surround fatty cysts.

There appears to have been a deep-seated inflammation resulting in necrosis followed by phagocytosis of fat—"granuloma lipophagique".

Cultures were negative after three weeks; a guinea-pig died three weeks after inoculation.

The Wassermann reaction is negative.

The patient has been treated with novarsenobillon. The front part of the lesion has disappeared but the back part is still present.

Discussion.—Dr. PARKES WEBER said that on the whole he preferred the term "lipophagic granuloma". In a sense "lipophagic granuloma" included all local subacute or chronic reactions which involved the breaking-up or destruction of fat cells (fat vesicles) in the subcutaneous tissue. The process, for instance, might be due to a subcutaneous injection of ether (F. P. Weber, *Brit. Journ. Child. Dis.*, 1925, **22**, 285). "Relapsing Febrile Nodular Non-suppurative Panniculitis" (F. P. Weber, *Brit. Journ. Derm. and Syph.*, 1925, **37**, 301, and 1935, **47**, 230) was possibly a very rare idiosyncratic mode of reaction towards iodides or bromides. Dr. Forman's present case seemed to be an example of erythema induratum (Bazin's disease), the most typical portion being at the back, not the front, of the leg. Professor Telford had rendered great service by his microscopical examination of the condition known as "erythrocyanosis" of the legs in young women. This seemed to be at first merely an idiosyncratic local vascular reaction towards cold, but in prolonged and neglected cases a kind of lipophagic granuloma resulted from the breaking-up of fat cells (fat vesicles) and their invasion by macrophages (lipophages), the broken-up fat continuing to act as a foreign body and giving rise to the characteristic formation of foreign-body giant-cells (as in "relapsing febrile nodular non-suppurative panniculitis" and in granuloma caused by the subcutaneous injection of ether).

Dr. GRAY said that, clinically, the case fitted in very well with a type described by Dr. Whitfield, namely, erythema induratum occurring in middle-aged women. He gathered from Dr. Muende that he had not found any crystals in the sections. He was under the impression that the presence of giant cells in large numbers was the result of foreign-body crystals in the tissue, which were present in ordinary traumatic necrosis.

Dr. PARKES WEBER (in reply to Dr. Gray) said that the presence of crystals was not necessary to produce what one might call a lipophagic granuloma, because the injection of various kinds of mineral fat sometimes did in certain subjects lead actually to a kind of lipophagic granuloma—a manifestation of chronic inflammatory tissue-reaction. Similarly, when various kinds of fats were inhaled into the lungs an inflammatory reaction sometimes resulted, which had been incorrectly termed "lipoid pneumonia".

Acne Agminata.—CLARA M. WARREN, M.R.C.S., L.R.C.P.

The patient is a youth aged 19, who first attended the West London Hospital in December 1937, with a six months' history of a rash on the malar prominences of the cheeks, across the bridge of the nose, and on the forehead. The lesions were isolated, raised, firm nodules, some having a translucent centre. The rash had appeared quickly, and there was nothing relevant in the previous history of the patient. A nodule was removed for biopsy, and Dr. R. G. L. Waller reported as follows:—

This section of skin shows subepithelial infiltration with granulomatous tissue. There are areas of endothelioid cells and a very occasional giant cell. Appearances are suggestive of tuberculosis, but no tubercle bacilli were found in the section.

The patient has had five injections of sanocrysin, followed by three months' general treatment by ultra-violet light, and there is now an improvement in the condition, the lesions having become flatter, and less pronounced.

Section of Laryngology

President—C. A. SCOTT RIDOUT, M.S.

[May 6, 1938]

The Action of the Larynx

(*Notes on a Cinematograph Demonstration*)

By JOEL PRESSMAN (Los Angeles)

THE work which I am about to report consists essentially of observations upon the action of the larynx, as demonstrated by a motion picture film. Many or all of the phenomena are well known, but the method of demonstrating them is probably less familiar.

I have had no interest in preparing a motion picture film *per se*. My sole interest has lain in learning and teaching what I could about laryngeal physiology and pathology. Early in the course of my studies in this subject it became apparent that certain things could be learned and demonstrated by no method other than that of moving pictures of the interior of the actively-functioning human larynx in fully conscious patients.

The development of the technique for taking these pictures is a story by itself, a discussion of which I purposely omit, preferring to describe the physiological facts that may be observed, since we are interested in this work as laryngologists, rather than as photographers.

The larynx has two chief functions, (1) to act as a passage for air, and (2) to produce sound. The first of these is not very complex, but there are one or two elementary observations worthy of mention.

The vocal cords at rest are relatively near the mid-line, partially occluding the lumen of the larynx through which inspired and expired air passes. There is sufficient space to allow the passage of volumes of air adequate for our needs at rest. However, under certain conditions, such as in singing or speaking, the area of the glottic chink at rest, would prove inadequate. A larger lumen for the passage of air becomes necessary, which the larynx provides by an increased abduction of the vocal cords. The degree to which the cords can be spread apart for increased respiration varies in different individuals, until we see in trained vocalists the ability to abduct them to an extreme degree. In a trained singer who finds it necessary to inhale as large a quantity of air as possible in the shortest possible time, the lateral excursion of these vocal cords upon inspiration is extreme, and as training and practice continue, it becomes possible to abduct them to such a degree that they come to lie almost flat against the lateral walls of the thyroid cartilage, presenting no obstruction whatsoever. This is not true of the ordinary untrained person whose extremes of movement are more limited. Thus the respiratory training to which a vocalist subjects himself, while ordinarily considered as diaphragmatic and abdominal exercises, is actually much more than that, and even though the pupil himself, or his teacher, may not recognize it, the result of such proper training is the development of ability to abduct the vocal cords more widely and thus render the larynx more patent, in order to allow the sudden ingress of larger quantities of air.

In the film the respiratory movements of a larynx at rest and those of a trained singer during respiration are shown. The ordinary respiratory movements of an untrained larynx are seen here and there throughout the film.

It is of some interest to consider the speed at which the vocal cords are capable of undergoing cycles of abduction and adduction. I do not at the moment refer to those independent vibrations producing tones of varying pitch. The cords can come together and separate, and undergo repetitions of this cycle through a wide range of speed, varying from very slow movements which all of us have repeatedly observed, to cycles so rapid that the human eye cannot even begin to follow them. The motion-picture camera is of some help, but not until we are able to obtain sequences in slow motion will it be possible to approach anything like an accurate estimate of potential speed of movement. This speed reaches its maximum in the tremolo voice. Our film passes through the camera at 16 frames a second, and in many frames when a tremolo voice is recorded it is obvious that more than one cycle of movement has taken place in a single frame.

The vocal cords when properly trained can undergo cycles of abduction and adduction at a speed greater than 16 cycles a second. They can therefore separate and forcibly approximate at a speed of over a thousand separate and distinct contacts a minute ; and these contacts of one against the other are not, as will be seen, light feathery touches, but are strong, forceful blows. The injury to which they are subjected during the lifetime of a singer must, therefore, be so great that it seems more appropriate to try to explain why traumatic laryngeal disease is not universal, rather than why erosive or inflammatory reactions occasionally occur.

The false vocal cords are neither remnants of vestigial organs nor functionless mucosal shelves serving no purpose, but on the contrary are important structures playing an active part in laryngeal physiology. The method by which they serve to protect the larynx from the invasion of foodstuffs during swallowing may be seen in the film—how, during deglutition they sweep across the larynx, sealing it from above and presenting a barrier through which foreign matter cannot pass into the lower respiratory passages.

The second function of these false vocal cords occurs under pathological conditions and does not exist in the normal larynx.

The film shows a short sequence of a larynx, the true cords of which have been completely destroyed by an extensive polyposis of more than twenty years' duration. They are, obviously, totally incapable of voice production. They undergo almost no movement and are unable to vibrate to produce sound. Yet this man had a voice ; husky, low-pitched, somewhat monotonous, but not nearly so much so as might have been expected from an examination of his larynx. As may be seen in the film, after these many years the false vocal cords have hypertrophied. Upon phonation they approximate, instead of retracting. In other words they are acting as true vocal cords, having assumed the function of phonation. Even after removal of the polyps and the restoration of a good anatomical appearance to the true cords, these false ones continue to act as phonatory organs, as though unwilling to surrender the performance of so important a duty.

We come now to the chief function of the larynx, which is sound production or phonation. This is carried out almost entirely by the action of the true vocal cords. In general, in order to produce sound waves, the cords are brought together in the mid-line, placed under tension by the action of the intrinsic muscles of the larynx, and stimulated into a state of vibration by a blast of air from below. Thus sound waves are produced in much the same way as sound waves emanate from a vibratory violin string when stimulated by the bow.

One preliminary observation concerning these vibrations is worthy of mention. By careful observation it may be seen in the film, that as the cords vibrate, producing a tone, the anterior two-thirds of the free margins of the cords appear fuzzy and are ill-defined, seemingly in a state of vibration, whereas the posterior third remains stationary, with its edge sharply defined, apparently taking no part in the vibratory movement. This may have some clinical significance

in regard to the site upon which vocal nodes ordinarily develop. At least, we can say with justification that the vibrations producing sound take place in large measures, or entirely, in the anterior two-thirds of the cords.

I wish to call particular attention to the mechanism by means of which the larynx is able to produce not one tone, but many. The human voice is not a monotone, but is composed of a wide range of tones. This variation is accomplished not by the utilization of any one principle of the physics of sound production, but by at least three that I can demonstrate, and possibly by others which I have not been able to recognize. To simplify the explanation of these variations that take place in changing from one tone to another I describe each of these phenomena as a distinct entity, whereas in fact no one of them is used at any one time to the exclusion of the others. I cannot at the moment describe anatomically the muscular actions which bring about these changes, but in a general way they are demonstrated in the film.

The first principle utilized by the larynx in changing its tone-level is the one we know well; a simple tightening or increase in tension of the cords as we ascend the scale. This is the application of the same physical principle as prevails when a violin string is tightened by its key, with a resulting elevation in pitch.

The second principle which is, I think, a new conception, is that of functional foreshortening. We know that given a vibrating string under fixed tension, if the vibratory length of this string be shortened the resulting tone will be higher. For instance, when a violinist advances his finger along a violin string the tone is elevated. What he has done is "damped" that portion of the string distal to his finger, and the resultant shortening of the vibrating portion of the string causes it to render a higher tone. In the larynx this same principle of foreshortening takes place by a varying length of one cord, beginning posteriorly, coming into firm contact with, and damping a corresponding length of the other, thus leaving only the anterior portions of the cords free to vibrate. In other words functional foreshortening has taken place. It must follow that the greater the length over which closure or contact takes place, the shorter the free vibrating segment of the cord becomes, and the higher is the resulting tone. Thus one cord damps the other, and as we ascend the scale the cords first touch each other posteriorly, the length of contact becoming progressively greater anteriorly, until, as we reach the highest tones, we find by far the greater length of the cords in contact with each other, and only a very short segment free to vibrate. A tiny chink exists, which represents all that remains of the airway through the larynx.

This observation automatically brings us to the third means available to the larynx for elevating the pitch. As portions of the cord come into contact one with the other, the existing area between them becomes smaller and smaller. Given a fixed amount of escaping air under fixed pressure, the smaller the orifice through which this air escapes, the higher is the resulting tone, as in certain types of whistles. Therefore, as the cords come together in increasing lengths for purposes of damping, as a secondary result, the area between them becomes smaller and smaller, and as air passes through this increasingly narrowed orifice the resulting tone becomes higher and higher.

We see then that the elevation of the pitch of a tone emanating from the larynx results from any one, or from a combination of more than one, of three phenomena, taking place separately or in combination. These three phenomena, to sum up then, are first a tightening of the vocal cords, secondly a functional foreshortening by damping of selected lengths of one cord against the other, and thirdly a narrowing of the orifice between them, which automatically results from the foreshortening or damping process.

When the larynx produces its lowest possible tone, which is almost guttural, the cords are adducted nearly to the mid-line, but are relatively relaxed. No part of one cord is approximated to the other, and the space between them, already relatively

large, is further enlarged by an exaggerated bowing outward of the posterior thirds of both cords, to make a large hiatus posteriorly. As we ascend the scale, the hiatus disappears and the cords become more nearly parallel, continuing to come closer together until they finally touch at their most posterior tips. The posterior hiatus is thus completely obliterated and the damping process begins. As higher and higher tones are produced, more and more of the length of the cord comes into contact with its fellow, this contact beginning posteriorly and extending anteriorly as we go up the scale. Finally, as the larynx produces the highest tone of which it is capable, a great length of the cord is in intimate contact with the other, under great tension, and only the smallest conceivable opening, located anteriorly, exists between them.

All these points are illustrated in the film, which also includes a few sequences demonstrating pathological physiology.

Discussion.—Sir STCLAIR THOMSON said that he would like to know from Dr. Pressman whether the flickering which was noticeable on the vocal cords was due to the movement of the mucus. If so, it might be interesting to study the lubrication of the cords.

RICHARD WALDAPFEL (Vienna) said that it was customary to speak of the approximation of the vocal cords. It was evident from the film now shown that the cords were always approximating, but there remained a little space between them in every position except one, namely, the position assumed for the high tones. What the film had shown with regard to the muscular control of the cords for high, middle, and low tones, was quite new. It was only in the high tones, when the posterior parts of the cord were close together, that the approximation seemed to be absolute, with no space between. In that stage it was interesting to see how the ventricles on each side, which were placed between the true cords and the false cords, unveiled themselves and became much larger. It was when the cords were pressed against each other that the ventricles enlarged.

DOUGLAS GUTHRIE said that he, too, had been interested in the movement of the mucus on the cords to which Sir StClair Thomson had drawn attention. Another interesting point was the separation of the arytenoids during vocalization. He had always been taught that there was a vocal part of the glottis and a swallowing part, but apparently the action of the two parts was not so far separate as had been supposed.

Dr. PRESSMAN (in reply) said that, as Sir StClair Thomson had supposed, the flickering appearance seen was due to the mucus. He was gratified that the film should have been so clear that this was recognized. The trouble with mucus was that it reflected the light used for exposure and a good deal of the film had been wasted because of the glare produced by the shining of the light on the secretion. They had to be sure that there was not too much of it, but the fact that it was appreciable by an observer seeing the film for the first time, was certainly encouraging. The mucous membrane supplied to the shelf between the lateral wall and the cord overlying the muscle appeared to be insufficient in quantity to allow the cord to meet in the mid-line, and that extra mucosa must be supplied from somewhere else. It seemed to come partly from the ventricle and partly, by reciprocal action, from the false cord. The question of the removal of the false cords was very important; persons who had had the false cords removed certainly suffered more frequent invasion of foreign bodies into the air passages.

The arytenoids approximated in talking, but in themselves had no real action in producing the tone; they were the means by which the cords were brought together and spread apart.

The possibility of studying the cords at higher camera speeds had engaged his attention and that of those associated with him. At present it was technically impossible. The technique was not yet sufficiently accurate to enable the speeding-up of the photography to a higher degree than in the film just projected. The difficulty was to find films sufficiently sensitive and to use light of sufficient intensity. If slow-motion pictures of the larynx could be produced they would certainly be valuable and would probably disclose many things as yet unknown about the vocal mechanism. If, however, instead of the present 16 frames per second now used, any number up to 120 were to be used, so much more light would be necessary that the reflections produced would throw everything out of focus.

Section of Medicine

President—H. LETHBY TIDY, M.D.

[May 24, 1938]

Dietetic Treatment of Diabetes Mellitus with Special Reference to High Blood-pressure

By DENNIS EMBLETON, M.A., M.B.

ABSTRACT.—The error in a diabetic is essentially a carbohydrate intolerance, and correction of this defect should be aimed at in treatment.

Dietetic treatment of diabetes is more readily studied in early cases or cases in the pre-diabetic state, before arterial degeneration and other catastrophes have become manifest. It is suggested that such a condition exists in obese subjects with a carbohydrate intolerance.

A high protein diet based on a study of these cases is brought forward.

This diet has been shown to operate favourably in diabetic states. Many cases of reasonable severity can be brought to develop a normal or nearly normal glucose tolerance curve and retain this state over a period of years. Cases in this state are better able to resist concomitant infections without deterioration of their tolerance than cases imperfectly balanced with insulin.

The high protein diet can be used in cases of hyperpiesia in the absence of gross kidney damage. These cases show a steady and lasting drop in blood-pressure without the necessity of employing rest.

The value of the pure fruit diet in increasing tolerance of certain diabetics to carbohydrate is demonstrated.

The indiscriminate use of insulin in hyperglycæmic states is deprecated on the grounds that it is frequently unnecessary, and though it may balance it does not necessarily rectify the main deficiency of carbohydrate intolerance.

By the use of this simple high protein diet, where no weighing, &c., is required, a large number of diabetics at present on insulin could be readily dealt with, a return to a normal or nearly normal glucose tolerance curve being obtained and maintained.

RÉSUMÉ.—L'erreur fondamentale chez le diabétique est une intolérance pour les carbohydrates, et le traitement doit se diriger vers la correction de ce défaut.

Le traitement diététique du diabète peut être étudié plus facilement dans les cas récents ou dans l'état pré-diabétique, avant que la dégénération artérielle et d'autres catastrophes se soient manifestées. L'auteur suggère qu'un état de cette sorte existe chez les sujets obèses avec intolérance pour les carbohydrates.

Un régime riche en protéines, fondé sur une étude de ces cas est préconisé. Il a été démontré que ce régime exerce une action favorable sur l'état diabétique. Beaucoup de cas de gravité modérée peuvent être amenés à développer une courbe de tolérance pour la glucose normale ou presque normale, et cet état peut être maintenu pendant plusieurs années. Les malades dans cet état résistent mieux aux infections concomitantes sans détérioration de leur tolérance que ceux mal équilibrés par l'insuline.

Le régime riche en protéines peut être employé dans les cas d'hypertension sans lésion rénale sérieuse. Dans ces cas on obtient une baisse constante et durable de la pression artérielle sans devoir recourir au repos.

La valeur du régime exclusif de fruits en augmentant la tolérance de certains diabétiques pour les carbohydrates est démontrée.

L'emploi sans discrimination de l'insuline dans les états d'hyperglycémie est à éviter, parce qu'il n'est souvent pas nécessaire, et quoiqu'il puisse compenser au défaut essentiel, c'est-à-dire à l'intolérance pour les carbohydrates, il ne le corrige pas nécessairement.

Beaucoup de diabétiques à présent traités par l'insuline pourraient facilement être traités par l'emploi de ce régime simple, ne nécessitant pas de pesage, &c., et résultant en un retour persistant d'une courbe de tolérance pour le glucose normale ou presque normale.

ZUSAMMENFASSUNG.—Das Wesen der dem Diabetes zu Grunde liegenden Störung ist eine Intoleranz für Kohlehydrate und Ziel der Behandlung sollte die Beseitigung dieses Zustandes sein.

Zum Studium der diätetischen Behandlung des Diabetes eignen sich besonders Fälle im Frühstadium oder im prädiabetischen Stadium, bevor arterielle Degeneration und andere Katastrophen in Erscheinung getreten sind. Es wird die Vermutung ausgesprochen, dass ein solcher Zustand bei Fettstüchtigen mit Intoleranz für Kohlehydrate vorliegt.

Auf Grund der Beobachtungen an solchen Fällen wird Behandlung mittels eiweißreicher Kost vorgeschlagen. Es konnte gezeigt werden, dass eine solche Kost in diabetischen Zuständen günstig wirkt. In vielen mittelschweren Fällen wird die Blutzuckerkurve wieder vollständig oder nahezu normal und bleibt so während mehrerer Jahre. In diesem Zustand ist die Resistenz solcher Fälle gegen gleichzeitig auftretende Infektionen höher als bei Fällen die nur unzureichend mit Insulin eingestellt sind, u.zw. ohne dass dabei eine Beeinträchtigung der Zuckertoleranz auftritt.

Eiweißreiche Kost kann bei Fällen von arteriellem Hochdruck angewendet werden, sofern keine groben Nierenschädigungen vorhanden sind. Derartige Fälle zeigen eine stetige und andauernde Senkung des Blutdruckes ohne dass Verordnung von körperlicher Ruhe notwendig wäre.

Es wird gezeigt, dass bei manchen Diabetikern eine ausschliessliche Fruchtdiät ein wertvolles Mittel zur Verbesserung der Kohlehydrattoleranz ist.

Die wahllose Anwendung von Insulin bei der Behandlung hyperglykämischer Zustände wird abgelehnt, denn sie ist oft überflüssig, und wenn auch dadurch der Zuckerstoffwechsel symptomatisch eingestellt wird, so braucht die zu Grunde liegende Störung des Zuckerstoffwechsels dadurch nicht gebessert zu werden.

Viele Diabetiker, die derzeit Insulin erhalten, könnten gut mit dieser einfachen eiweißreichen Kost behandelt werden, eine Behandlungsmethode, bei der sich Wiegen, &c., erübrigt und bei der die Blutzuckerkurve wieder vollständig oder nahezu normal wird und so verbleibt.

THE INTRODUCTION OF INSULIN HAS LED TO THE NEGLECT OF THE PURELY DIETETIC TREATMENT OF DIABETES. Although many authorities advocate that dietetic measures should be first employed, it has become common practice to exhibit insulin as soon as the hyperglycaemic state is recognized.

Allen's work on the improvement in carbohydrate tolerance produced by starvation, while not forgotten, is seldom employed, and little attempt has been made to carry this line of thought further, or to investigate the articles of diet the withholding of which improves the tolerance. Attention at the moment appears to be focussed rather on improving the general condition of the patient than on attacking the main defect in diabetes which is—carbohydrate intolerance. It has become a common practice to place the patient on a so-called high carbohydrate diet, the excess of sugar being balanced off more or less accurately with insulin. This is followed by a marked improvement in many cases, less insulin being required and relatively large amounts of carbohydrate being dealt with without much rise in blood-sugar or urinary sugar output. It has, however, not been my fortune to discover a case of any severity treated on these lines, capable of eventually giving a normal or near-normal blood-sugar curve to 50 gm. of glucose, though such cases no doubt exist. It would seem that the more rational method of attack would be to aim at reducing the glucose tolerance curve to normal.

THE PRE-DIABETIC STATE

The late Sir John Rose Bradford stated some years ago that :—

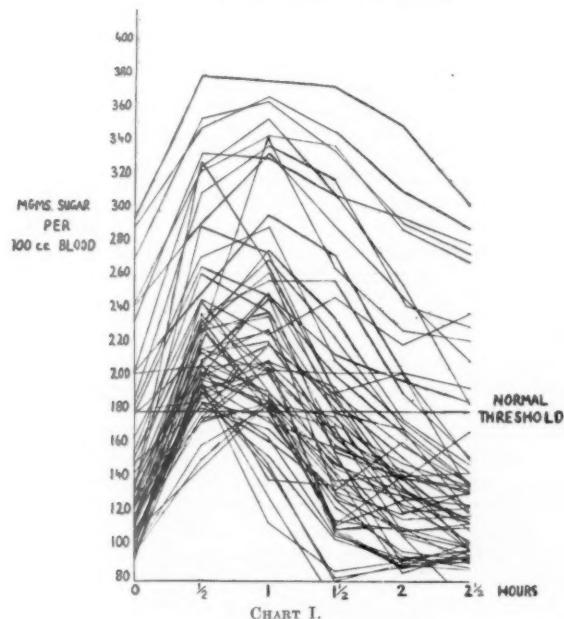
"Diabetes is not an entity, but a clinical label attached to a number of different conditions with varied origin, different morbid anatomy, and liable to follow different courses."

It has since been realized that there is a number of conditions associated with

hyperglycæmia which would not to-day be regarded as diabetes, viz. hyperthyroidism, &c. Diabetes, recognizable clinically, is rather the end-result of a series of catastrophes than a primary condition. As in any endocrine disturbance, the original error in diabetes may be overlaid by symptoms caused by the failure of other systems which have been thrown out of gear by the initial defect. The hyperglycæmic state, the result of the original error in diabetes, is in itself symptomless. It is not until this state produces secondary troubles such as polyuria and thus thirst, or arterial degeneration, or wasting, that the condition becomes clinically recognizable as diabetes. If the symptomless or pre-diabetic state could be recognized, it would constitute the best material on which to test the effect of treatment directed towards improving the diabetic syndrome.

GLUCOSE TOLERANCE TESTS.

66 OBESE MALES AFTER TAKING 50 GRMS. OF GLUCOSE



The history of an obese phase is relatively common in one class of diabetics. The pre-diabetic state in these cases might be considered to extend to the time when clinical symptoms of diabetes supervene. In this paper the approach to the dietary treatment of diabetics has been made through these cases.

A defect in carbohydrate tolerance is not uncommon in the obese, as has been reported by numbers of observers. But what does not appear to have been recognized is that there is a distinct difference in the frequency of abnormal glucose tolerance curves in the male and female. From 500 cases, I have been able to show that a raised glucose tolerance curve is present in some 73% of obese males, but in only 35% of females.

Chart I shows the superimposed glucose tolerance curves of 66 cases of obesity in the male, after 50 grm. of glucose. The higher curves were from obese cases of frank

clinical diabetes, while the lower series could only be regarded as obesity with no diabetic symptoms but a carbohydrate intolerance. At no level could a line be drawn to distinguish these two conditions. It is difficult to resist the contention that the conditions are essentially similar, the only difference being one of degree. Subjects with the lower graphs might therefore be looked upon as in the pre-diabetic state. Support was lent to this contention by the fact that nearly all these cases were treated, and all who were yielded to the same line of treatment, a normal, or nearly normal, curve being subsequently obtained.

THE HIGH PROTEIN DIET

The diet described in this paper was originally devised fifteen years ago for the treatment of obese cases with this carbohydrate error, and in the intervening period has been used on some 300-odd overweight cases. The diet was built up by a process of trial and error on these cases. The effect of foodstuffs on the blood-sugar level and/or weight was watched, substances producing a rise in either being reduced or eliminated. It was soon appreciated that a foodstuff which tended to produce a rise in blood-sugar level, tended also to produce a rise in weight, the increase in blood-sugar and weight being correlated.

I was fortunate in having in my laboratory an obese subject of just over 20 st., over 6 ft. 6 in. in height, and aged 41, on whom to work! This subject had glycosuria and was found to have a considerable defect in the glucose tolerance, passing 2 per cent. sugar one hour after 50 grm. of glucose. With this observed error in carbohydrate metabolism, the first step was to cut down carbohydrate. The subject having a healthy appetite and a natural distaste for starvation (or as it is euphemistically described, a low-calorie diet) decided to try if other substances could be taken with impunity. It was at once appreciated that if the carbohydrate intake was diminished, protein could be taken in large quantities, with a consequent drop in weight and lowering of the blood-sugar. The items of the carbohydrate group which were not tolerated, and which had the worst effect on both blood-sugar level and weight, were (1) Alcohol—very bad. (2) Saccharose—bad. (3) Starch—better tolerated. Fruit, on the other hand, appeared to be well tolerated in large quantities. Fats, oils, butter, were at first restricted, but when the weight was once falling, fats and oils could generally be added to the extent desired.

In this way the diet was gradually built up, until the scheme shown in Table I was arrived at. The essential constituents of any meal are thus: 1 oz. bread or its equivalent (exact); a minimal quantity of 3-4 oz. of protein for a male, 2-3 oz. for a female, or as much as desired; a compulsory 4 oz. at least of fruit; the "green vegetable list" is not restricted, except in cases of flatulent dyspepsia. Thus, although at any meal the starch is strictly limited to 1 oz. bread or its equivalent,

TABLE I.—HIGH PROTEIN DIET.
Compulsory constituents of diet:—

<i>Male</i> —	<i>Breakfast</i>	<i>Lunch and Dinner</i>	<i>Tea</i>
Bread ...	1 oz. exact	1 oz. exact	1 oz. exact
Protein ...	3-4 oz. or more	3-4 oz. or more	2 oz. or more (4 oz. allowed)
Fruit ...	4 oz. or more	4 oz. or more	
<i>Female</i> —	<i>Breakfast</i>	<i>Lunch and Dinner</i>	<i>Tea</i>
Bread ...	1 oz. exact	1 oz. exact	1 oz. } may be omitted
Protein ...	2-3 oz. or more	2-3 oz. or more	2 oz. (4 oz. allowed)
Fruit ...	(4 oz. allowed)	4 oz. or more	
<i>Allowed at any meal:</i> Water, <i>ad lib.</i> off meals. 8 oz. cup of tea or coffee at breakfast and tea.			
Green vegetable list, <i>ad lib.</i> (in absence of digestive disturbance).			
Condiments—salt, pepper, mustard, vinegar, olive oil.			
Butter and fats not limited (unless acetone).			
Milk, 1½ pt. when established.			
Cream, <i>ad lib.</i> when established.			
<i>Forbidden:</i> Sugar, alcohol.			
<i>Exchanges:</i> 1 oz. bread may be exchanged for—3 Ryvitas or Vita-weat, or 3 tablespoonfuls of root vegetable, except old potatoes.			

there is no upward limit to the protein or fruit ; as much of these as desired is allowed, and the patients are encouraged to satisfy their appetite in these directions. In men who are not taking food at tea it is recommended that half the bread allowance at tea should be transposed to lunch and half to dinner. (Bread is never allowed at any meal unless protein is taken at that meal.) If possible, the patient is persuaded to give up eating at this meal, and to be content with tea and milk alone. When the weight is falling in the obese, and the urine is sugar-free in the diabetic, milk is added up to $1\frac{1}{2}$ pints, and cream if desired. An example of the diet as given to the female patients is shown in Table II.

TABLE II.—FEMALE DIETARY.
(As given to Patient.)

<i>First thing</i> : Water, $\frac{1}{2}$ pt. Tea and lemon may be substituted; no milk.
<i>Breakfast</i> : Bacon, 1 rasher (about 1 oz.) and 1 egg, or fish (2 to 3 oz.).
Tomatoes, mushrooms, <i>ad lib.</i> See green vegetable list.
Bread, 1 oz. Butter, $\frac{1}{2}$ oz.
Tea or coffee, 1 breakfastcup, 8 oz.; milk, 1 oz.
<i>11 a.m.</i> : Water, $\frac{1}{2}$ pt. Fresh lemon juice, if desired.
<i>Lunch</i> : Meat, fish, bird, egg or cheese (totalling a minimum of 2 to 3 oz.).
Green vegetable list, <i>ad lib.</i>
Bread, 1 oz.; butter, $\frac{1}{2}$ oz.
Fruit, 4 oz. at least, apple, pear, or orange—or equivalent weight in other fresh fruit may be taken raw, baked, or stewed, without the addition of sugar.
Baked custard or junket may be taken.
A wineglassful only of water may be drunk; or black coffee.
<i>Tea</i> : Bread, 1 oz. Butter, $\frac{1}{2}$ oz.
Potted meat, fish, or egg, a good helping. } may be omitted.
Green vegetable list, <i>ad lib.</i>
Tea, 1 or 2 cups; milk, 1 oz.
<i>Dinner</i> : Similar to lunch.
<i>Last thing</i> : Water, $\frac{1}{2}$ pt. 1 teaspoonful of marmite may be taken here.
<i>Note</i> : No alcohol. No sugar allowed.
Water may be drunk up to half an hour before a meal, or two hours after.
Bread may not be taken unless accompanied by meat, &c.
3 pieces of Ryvita or Vita-weat may be substituted for 1 oz. bread.
1 Ryvita may be exchanged for 1 tablespoonful of pea, broad bean, or root vegetable, other than old potato.
Leaf gelatine—not bought jellies—may be used for making jellies with the fruit allowance (lemon sponge, &c.).
Saxine may be used to sweeten, but should not be cooked.
Milk up to $1\frac{1}{2}$ pt. a day, when established.
Cream <i>ad lib.</i> at meals after the first month, on request.
<i>Bowels open twice a day.</i>

The diet is very full and satisfying, provides ample energy for heavy physical exercise, and is well tolerated over long periods of time. It has been used for training for club Rugby football, cross-country running, rowing, and the centre court at Wimbledon. The desire for sugar and sweet foods usually diminishes in a fortnight. Digestional disturbances generally disappear or can be alleviated with slight adjustment. Stress has always been laid on the importance of obtaining two good actions of the bowel each day.

With normal digestion it has been shown that protein produces little alteration in the blood-sugar level in spite of the fact that 58% of the protein molecule can be utilized on the carbohydrate side. It is probable that this source of energy has not been more exploited in the past, owing to the unsatisfactory results following the administration of protein in partially de-pancreatized dogs. In these animals it has since been shown that the deterioration was attributable rather to the lack of digestive ferments of the pancreas than to a lack of insulin.

The influence of the high protein diet on blood-pressure.—Tables III and IV show blood-pressure observations on a series of patients taking this diet. In no cases have these patients been kept at rest, but all have been living a normal life. Rises in blood-pressure of a transitory duration have occurred following constipation or severe emotional strain. An example can be seen in Mrs. H. whose blood-pressure rose

subsequent to a drinking bout induced by the desertion of her husband. The diet when managed satisfactorily tends to produce a steady and lasting drop in the blood-pressure to normal figures.

TABLE III.—SYSTOLIC BLOOD-PRESSESURES, 180 OR OVER.

Name	Age		Weeks (approx.) on Diet										
			0	1	2	4	6	10	15	20	30	35	40
Mr. P.	51	Systolic	190	—	176	150	—	160	170	—	—	—	—
696		Diastolic	90	—	88	74	—	86	88	—	—	—	—
Mr. S.	52		190	154	134	160	160	—	—	—	—	—	—
890			120	96	88	40	110	—	—	—	—	—	—
Mrs. H.	58		180	—	—	—	154	125	150	166	—	170	—
894			96	—	—	—	94	72	92	90	—	104	—
Miss M.	45		180	—	164	170	158	148	138	158	150	—	152
950			94	—	94	94	90	78	78	84	90	—	78
Mrs. B.	52		184	174	160	148	150	150	158	146	152	—	160
954			108	98	98	78	92	80	88	84	90	—	94
Mr. J.	22		182	140	140	—	160	158	144	142	146	—	125
974			106	94	76	—	70	76	76	68	78	—	74
Mr. S.	53		196	156	178	172	164	138	140	126	124	—	—
1009			110	100	110	118	108	96	98	90	92	—	—
Miss R.	32		186	—	150	138	132	134	144	142	136	118	120
1011			70	—	62	82	68	68	72	68	64	62	70
Mrs. G.	67		180	130	140	—	132	138	—	—	—	—	—
1185			92	76	76	—	76	80	—	—	—	—	—

TABLE IV.—SYSTOLIC BLOOD-PRESSESURES, 200 OR OVER.

Name	Age		Weeks (approx.) on Diet										
			0	2	4	6	10	15	20	25	30	35	40
Mrs. L.	65	Systolic	210	185	—	165	155	140	144	140	—	—	—
658		Diastolic	100	100	—	80	80	80	86	68	—	—	—
Mr. B.	40		202	184	144	160	144	146	150	138	—	—	—
806			110	90	74	88	80	80	90	76	—	—	—
Mrs. C.	66		218	162	148	166	152	136	160	—	—	148	—
893			108	90	82	100	98	78	80	—	—	86	—
Mr. D.	19		214	160	170	170	172	162	—	—	—	—	—
899			90	88	100	92	98	80	—	—	—	—	—
Mrs. B.	59		200	178	168	152	160	156	156	160	162	152	150
1001			100	100	90	94	92	94	88	90	94	90	94
Miss D.	69		218	164	182	168	—	—	174	—	—	—	168
1120			104	84	88	92	—	—	90	—	—	—	90
Mrs. C.	62		200	160	124	142	128	140	144	134	150	138	—
1155			100	94	76	88	78	89	90	88	92	80	—
Mr. W.	63		202	—	150	—	142	146	—	—	—	—	—
1209			118	—	88	—	84	90	—	—	—	—	—
Mrs. P.	60		208	176	164	150	154	—	—	—	—	—	—
1219			108	98	88	76	86	—	—	—	—	—	—

The fruit diet.—There is another diet which has been found useful in moderate diabetics (Table V), unlimited but compulsory fruit every two hours. No other foodstuff at all is allowed on days when this diet is being employed. As this diet is apt to be constipating, extreme care has to be taken to combat any tendency in this direction.

TABLE V.—FRUIT DIET.

Compulsory: Fruit or fruit juice to be taken two-hourly throughout the day.

7 a.m. 11 a.m. 3 p.m. 7 p.m.

Half a glass or more of fruit juice, e.g. an orange, or two oranges and a lemon or grapefruit.

9 a.m. 1 p.m. 5 p.m. 9 p.m.

As above, or stewed fruit (no sugar), or fresh fruit unlimited.

So long as fruit or fruit juice is taken at two-hourly intervals, it does not matter how much is taken.

No sugar must be added; Saxine may be used to sweeten, but must not be cooked.

As much water as desired may be taken.

Fruit juice may also be taken at night.

No other foodstuffs at all must be taken.

N.B.—Pure fruit diet is apt to be constipating.

Bowels: Two actions per day.

Chart II is that of an obese male with a rather severe break in his glucose-tolerance curve, 2% urinary sugar being passed at one hour, a typical pre-diabetic state. A completely normal curve was obtained six months after starting the high protein diet.

Chart III (p. 42) is an example of another obese male. Here it is seen that at the end of three months' treatment, practically no alteration in the curve or weight had occurred. The teeth had been reported sound, but X-rays showed that two molars had marked apical infection. These teeth were removed, and three months later the curve was normal and the weight had come down well. This is rather a dramatic example of the importance of a careful elimination of all septic foci. It is well known,

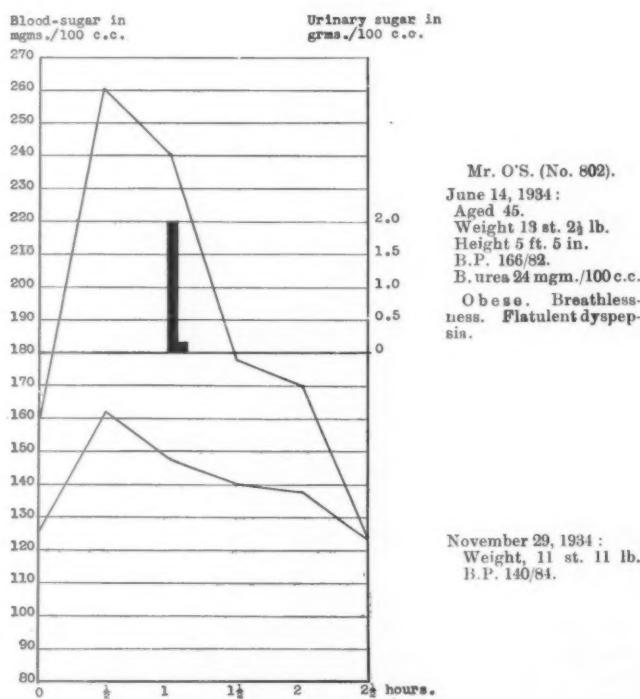
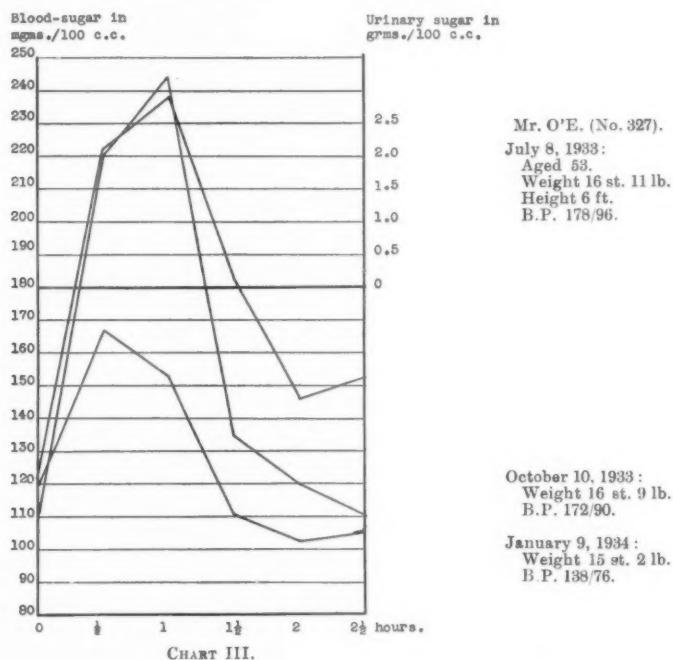


CHART II.

of course, that sepsis is dangerous in diabetic cases. It would appear that it is also important in these obese subjects. It has now become the rule that in all cases in which the expected response to the diet does not occur, a further investigation with reference to sepsis or intestinal stasis should be made.

Chart IV (p. 43) is that of a woman with a fairly high glucose-tolerance curve, but no symptoms of diabetes. This case might be reasonably regarded as an early case of diabetes, and, as in all subsequent cases dealt with in this paper, insulin had been

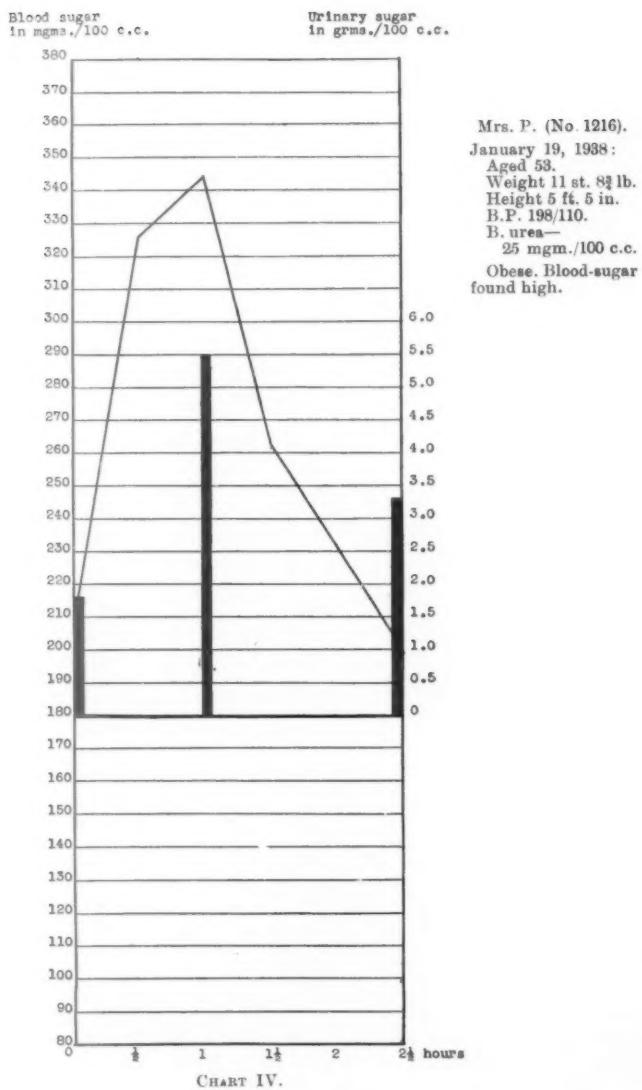
recommended. She was an obese subject and forms a link between the simple obese cases in the pre-diabetic state and those with undoubtedly diabetes. Table VI (p. 45) shows her response to early treatment. For the first three days she was on the high protein diet and showed some improvement in the urine tests. On January 25 and 26, the pure fruit diet was instituted, and although there was some increase in urinary sugar in the early part of the first day, the specimens before and after dinner were sugar-free. On January 27, the standard diet was re-instituted and was followed by a somewhat improved tolerance, but the patient broke her diet in the evening. The

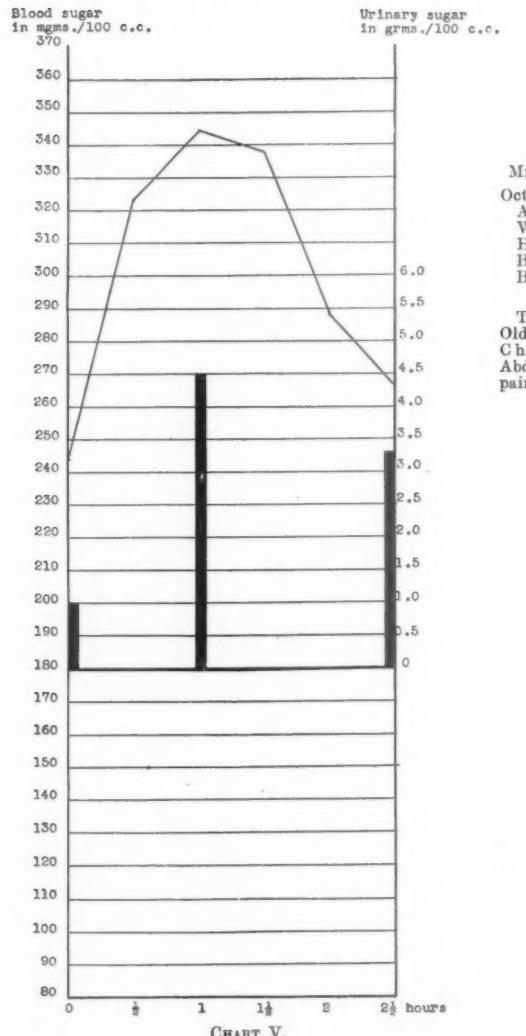


two subsequent days, January 28 and 29, showed no consistent improvement. On January 30 and 31, two more fruit days were instituted. On February 1, no sugar was found in any specimen, showing a marked improvement in the tolerance produced by the fruit diet. On February 4 and 5 further fruit days were instituted, with satisfactory results. Subsequent to this period only the merest trace of sugar was found in the urine. The improvement in blood-pressure and weight is noteworthy in this table.

(N.B.—In the graphs—Tables VI-XI—"S." = high protein diet; "F" = fruit diet.)

Chart V (p. 44) shows the glucose tolerance curve in a male who had symptoms of thirst and polyuria. This was a case of old duodenal ulcer with chronic gastritis, and abdominal epigastric pain had restarted. This patient was definitely suffering from clinical diabetes. Table VII (p. 45) shows his early response to treatment. Following the exhibition of the high protein diet there was a fairly rapid improvement in the urinary sugar excreted, but a considerable quantity of acetone appeared. For this reason





Mr. B. (No. 1194).

October 5, 1937:

Aged 55.

Weight 14st. 4 lb.

Height 6 ft. 1 1/2 in.

B.P. 160/84.

B. urea—

23 mgm./100 c.c.

Thirst. Polyuria.

Old duodenal ulcer.

Chronic gastritis.

Abdominal epigastric

pain.

extra orange-juice drinks were given at 7 a.m., 11 a.m., 3 p.m., and 10 p.m. This did not appear to increase the amount of sugar in the urine. On October 26, he started three fruit days; on October 29, he went back on the high protein diet and passed practically no sugar throughout the day. Subsequent to this only a trace of sugar appeared in the urine, and the acetone gradually faded out. This again demonstrates the improvement in tolerance following the exhibition of pure fruit.

TABLE VI.

Chart VI (p. 47) is that of an elderly diabetic who had suffered from thirst and loss of weight ($1\frac{1}{2}$ st. in two years). Table VIII (p. 48) shows his response to treatment. After the first exhibition of the fruit diet there was little general improvement in the urinary sugar, although the last specimen on the second day showed no sugar. The early morning specimen of urine from this time became sugar-free. Following the second exhibition of three days on fruit, almost completely satisfactory results of urine examinations were obtained, and subsequently sugar disappeared from the urine almost entirely.

Chart VII (p. 49) shows three glucose tolerance curves in a male Hindu. In the initial curve the blood-sugar was outside the Hagedorn and Jensen range from the half-hour to the two-hour period. Two months later there was a considerable improvement in the glucose tolerance, and after the patient's return to India some eight months later, the curve had so much improved that it could hardly be recognized as that of a diabetic. Table IX (p. 50) shows his response to early treatment. After the first exhibition of three fruit days, there was a considerable

URINES AT:-	BREAKFAST				LUNCH				DINNER				MR. B. 1194.	Weight	B/P	FEHLING'S TESTS ON URINE				
	Before		2hrs After		Before		2hrs After		Before		2hrs After						Sugar		Acetone	
	DATE	DET	Sugar	Acetone	Sugar	Acetone	Sugar	Acetone	Sugar	Acetone	Sugar	Acetone	+	++	+++	+				
Oct. 18													+++	+++	+++					
19 S			++		++		+		+		++		++	++	++		13. 11	160/94		
20 S			++		+		+				++		++	++	++					
21 S			+		++		++		++		++		++	++	++					
22 S			+		++		++		++		++		++	++	++					
23 S			+		+		+				+		+	+	+					
24 S			+		++				+		++		+	+	+					
25 S			+		++				++		++		++	++	++		13. 4			
26 F			+		+		++		+		+									
27 F					++		+													
28 F																				
29-31 S													++	++	++					
Nov. 1 S									++		++		++	++	++		13. 3½	128/76		
1-5 S																				
6 F																				
7 F																				
8 S																				
9 S																				
10 S																				
11 S																				
12 S																				
13 S																				
14 F																				
15 F																				
16 F																				
17 S																				
18 S																				
19 S																13. 5	106/60			
20 S																				
21 S																				

TABLE VII.

improvement in the urine, although this was not maintained for the next two to three days on the diet. The second application of fruit days was followed by completely perfect urine tests. The table is somewhat marred by the reappearance of sugar on July 27 and 28, when the patient attended the Indian Round Table Conference and became very excited. The results of subsequent tests were, however, satisfactory.

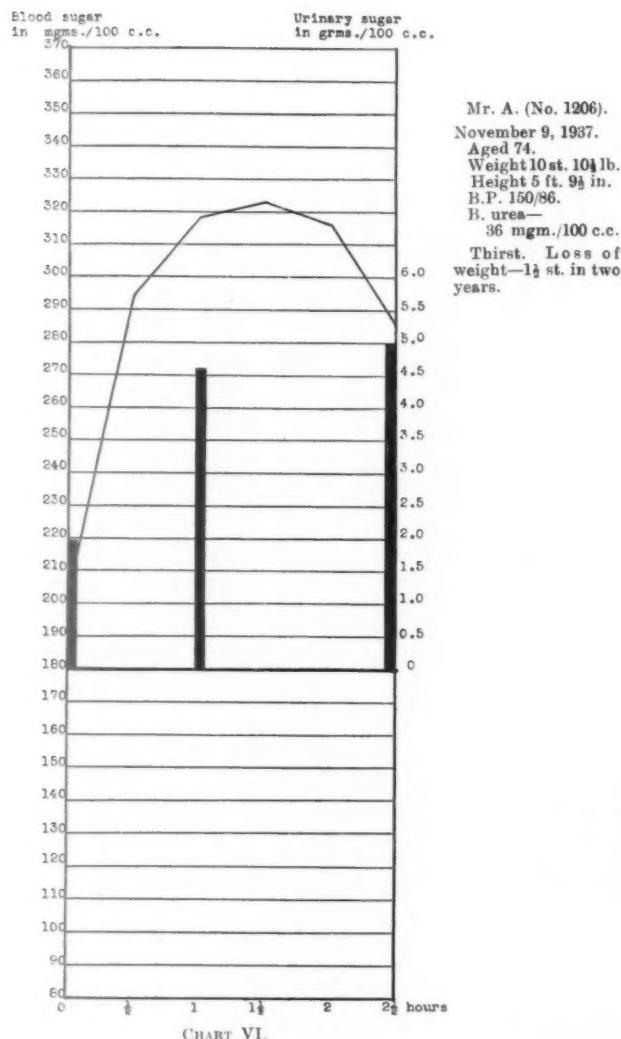


Table X (p. 51) : This was an emergency case. The patient had been on insulin for some three years, and was at the time taking 18 units. He had already lost one leg through diabetic gangrene, and a discharging sinus, with some necrosis of bone, had begun in the fourth toe of the remaining foot. On admission he had been constipated for five days, the blood-pressure was 202/104, and the urine was heavily infected with a staphylococcus and contained albumin 1.0 per mille, also sugar and acetone. No

TABLE VIII.

arterial beat could be detected digitally in the foot. He was immediately put on to a pure fruit diet for one day, and the bowels were cleared with an enema. During the next five days he received the standard diet with 5 units of insulin before breakfast. Insulin was eventually dropped on January 26 while the patient was on the two fruit days. The day following the fruit diet showed a considerable improvement with regard to the urinary sugar. Owing to the rather marked drop in blood-pressure that occurred on this day, fruit days were withheld until February 8. The general picture

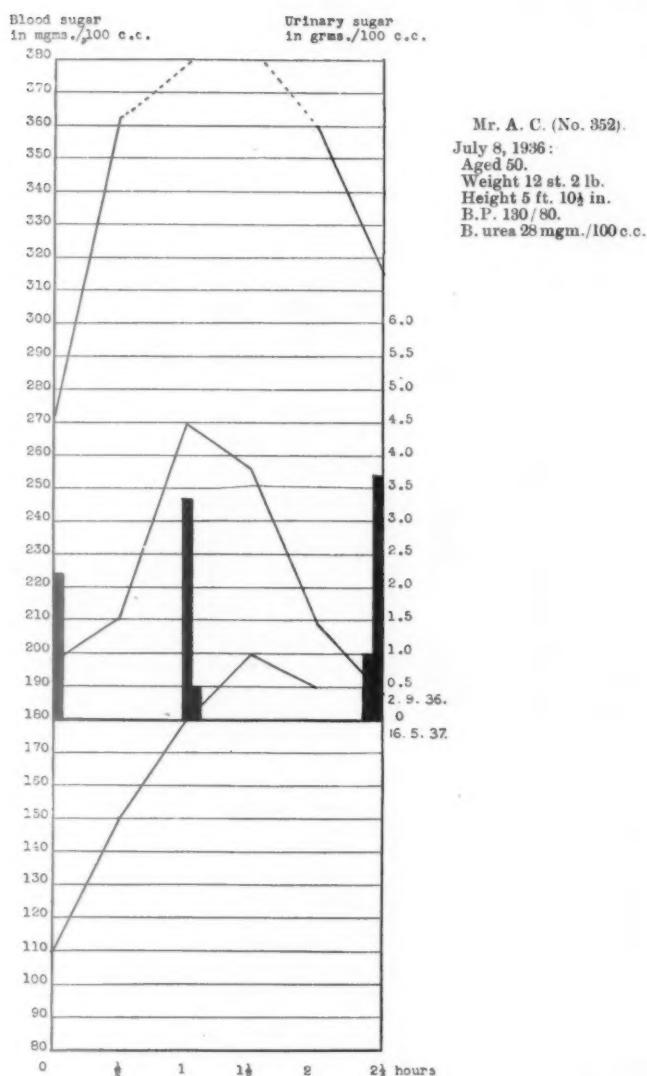


CHART VII.

during this period was fairly good, particularly in view of the fact that insulin had been discontinued, but there was an irregular occurrence of sugar in the urine. It must be noted, however, that the patient was very septic and also was subjected to severe emotional strain—(1) the fear of losing the remaining leg, and (2) he was at the time becoming bankrupt. On February 18 the necrosed bone was removed under an anaesthetic. The response was not so quick in this case, but there is definite evidence of improvement after the exhibition of fruit, and eventually the urine became sugar-free entirely and continued so.

TABLE IX.

Chart VIII (p. 52) is that of a male diabetic, overweight, with raised blood-pressure, loss of sensation in both feet, and calcification of arteries in the legs (shown by X-rays); arteries not palpable in the feet, which were cold to touch. Subsequent curves, two years later, show very marked improvement in glucose tolerance and could hardly be regarded as that of a diabetic. Sensation in both feet became normal, and the

blood-pressure remained fairly steady round about 146/78. Table XI (p. 55) shows his response to treatment. His first fruit days appeared to improve his tolerance, but on April 4 the picture was spoilt by the administration of 50 grm. of glucose for a glucose tolerance curve. In spite of this, however, the urine was still sugar-free in the evening specimen. The next two days were not so good. On April 7, an experiment was tried to see if advantage could be gained by administering glucose with orange-juice. 25 grm. of glucose and a tumbler of orange-juice were given every

URINES AT:	BREAKFAST			LUNCH			DINNER			MR. H. 1223.	FEELINGS
	Before		2hrs After	Before		2hrs After	Before		2hrs After		
	Sugar	Acetone	Sugar	Acetone	Sugar	Acetone	Sugar	Acetone	Sugar		
DATE	DIET									Weight	B/P
Jan. 20	F									11. 6 $\frac{1}{4}$	202/104
21	S										174/94
22-24	S										
25	S										168/80
26	F										
27	F									11. 0	142/80
28	S										120/65
29 - 6.	S	+									
Feb. 7.	S	+									156/84
8	F										
9	F										152/78
10	S										
11 - 15	S									11. 0 $\frac{1}{2}$	160/76
16	F										+
17	F										+
18	F										Removal of Necrosed Bone in Toe
19	S	+++	++	++	+	+					
20	S										
21 - 22	S										158/80
23	F										
24	F										
25	S										168/78
26-1	S										
Mar. 2	F										
3	F										
4	S									11. 1	156/78
5 - 9	S										
10	F										
11	S										162/90
12	S										

TABLE X.

two hours from 6 a.m. to 10 p.m. for two days. It is worth noting that the evening specimen on each of these two days was almost sugar-free. However, as there had been a considerable increase in the sugar output in the early part of the day, this scheme was discontinued, and two pure fruit days were instituted. On the second of these days, the urine was sugar-free throughout the day. This was remarkable, seeing that the patient had been for four days on a pure carbohydrate diet. The following day on the standard diet he was again entirely sugar-free. There was some set-back on April 14, followed by the fruit diet on the 15th which corrected the

TESTS ON URINE

- Reducing Sugar. + +
- Less. but + +
- 0.5% Sugar. or more
- Less than 0.5% Sugar
- NO Sugar

Jan. 21-25
5 units
Insulin
mane.

ROTHERA'S TEST FOR ACETONE

- +++ Strongly present.
- + + Medium.
- + Slightly present

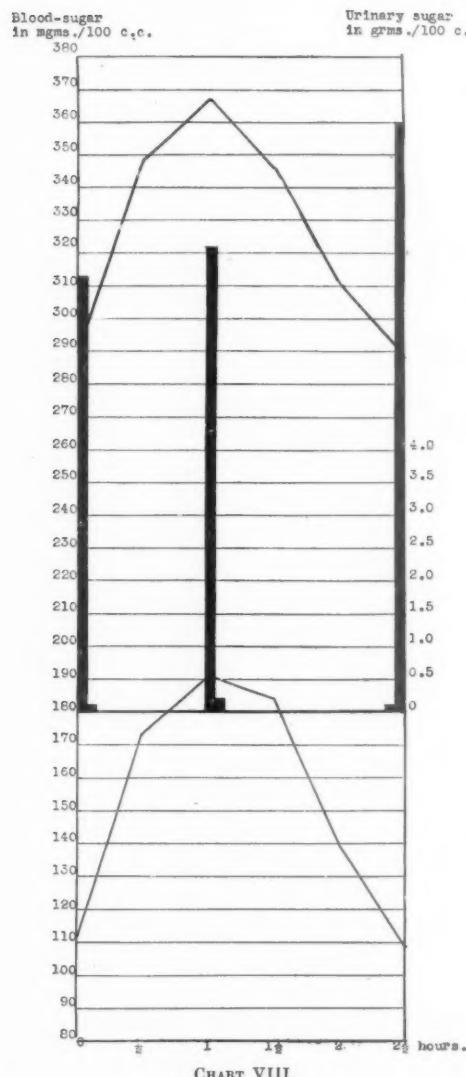


CHART VIII.

error. Two subsequent fruit days were given on April 20 and 21, followed by entirely normal sugar-free urine. Chart IX shows the patient's subsequent improvement on the standard diet.

As has been shown in the previous cases, the high protein diet and fruit diet are alternated. Fruit days are instituted as soon as deterioration in urinary sugar occurs on the protein diet. As soon as the patient is able to last five days without urinary sugar appearing, two fixed fruit days per week are given. This scheme is continued until a satisfactory blood-sugar response is obtained to the protein diet. A tolerance curve to 50 gm. of glucose is then performed. If the result is satisfactory the fruit days are discontinued or given at longer intervals.

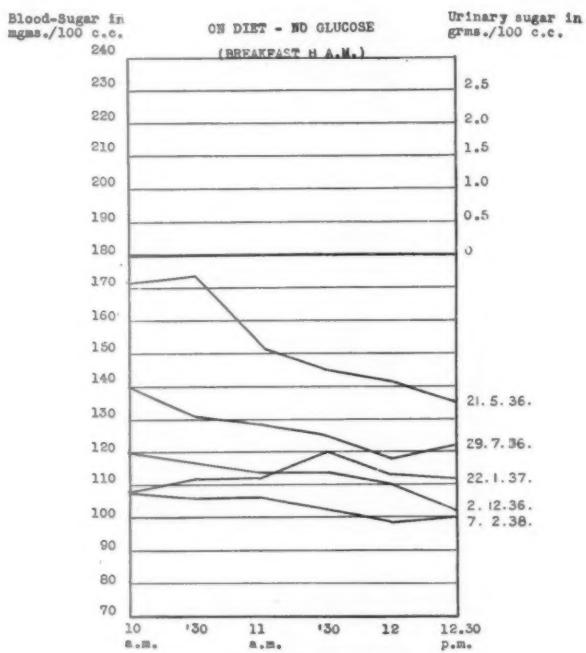


CHART IX. Mr. D. (No. 1030).

Chart X (p. 54) is that of an obese male, with auricular fibrillation, who had been known to have glycosuria for ten years. Three years ago, his blood-sugar level stood at 309 mgm. In his initial response to 50 gm. of glucose, his blood-sugar was above the Hagedorn and Jensen range, only dropping back at the two-hour and two-and-a-half-hour period. Six months later his glucose-tolerance curve was virtually normal. His general condition has been exceedingly good. He has withstood several sharp attacks of bronchitis, and although his heart is still fibrillating, his blood-pressure is somewhat improved.

Chart XI (p. 56) demonstrates the curve of an obese male with a raised blood-pressure. The curve at the one-hour went outside the Hagedorn and Jensen range. This patient had suffered from thirst and polyuria, and when first seen was in a state of pre-coma, being difficult to rouse. Three months later his curve, although not quite

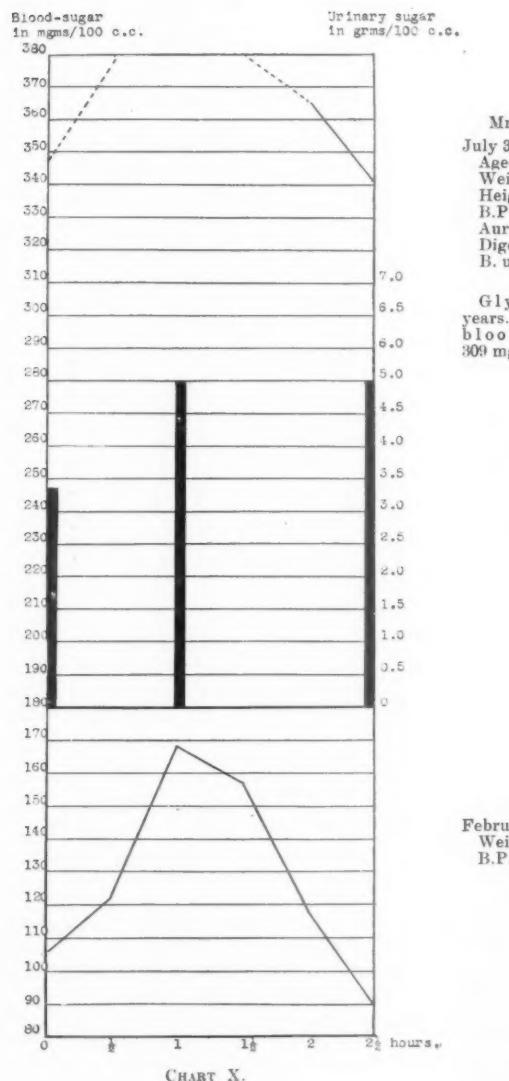
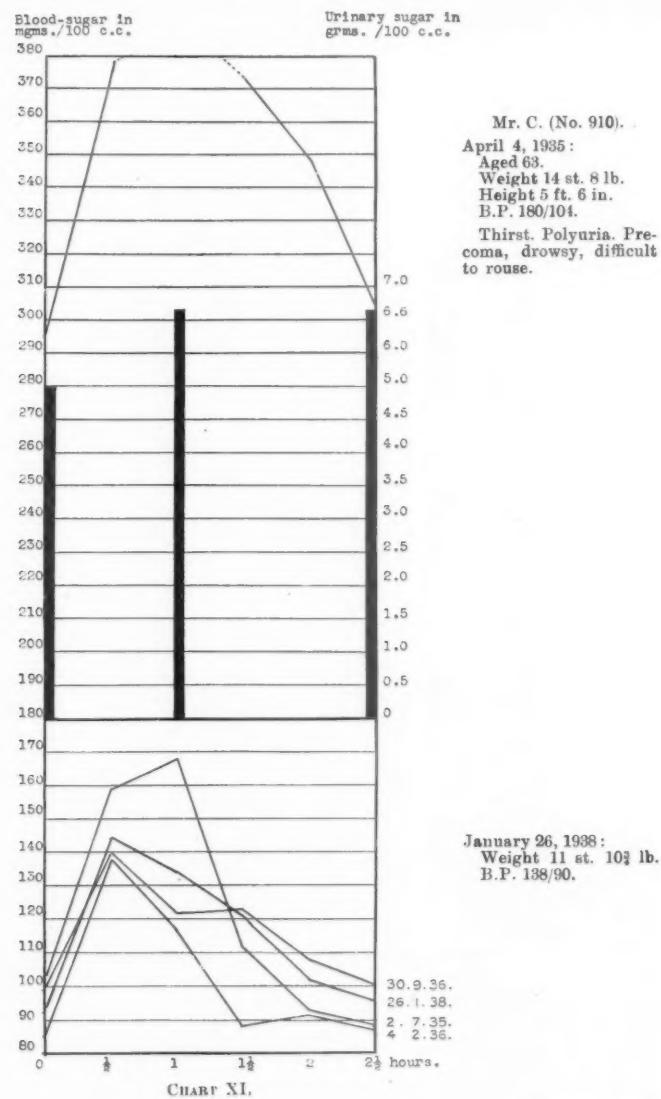


CHART X.

URINES AT:	BREAKFAST				LUNCH				DINNER				MR. D. 1030.	TESTS ON URINE	FEELINGS
	Before		2hrs After		Before		2hrs After		Before		2hrs After				
	DATE	DIET	Sugar	Acetone	Sugar	Acetone	Sugar	Acetone	Sugar	Acetone	Sugar	Acetone	Weight	B/P	
Mar. 27	S												14. 1	180/90	Reducing Sugar.
28	S		+		+										+++
29	S			+											Less.
30	S			+				+							but ++
31	S														0.5% Sugar. or more.
Apr. 1	F														Less than 0.5% Sugar.
2	F														NO Sugar
3	F														
4	S		50 grms. Glucose Tolerance Curve.										13. 6 $\frac{3}{4}$	148/78	
5	S														
6	S														
7															
8															
9	F												13. 1		
10	F														
11	S												13. 0 $\frac{3}{4}$		
12	S														
13	S														
14	S												130/90		
15	F														++ Strongly present.
16	S														++ Medium.
17	S														+
18	S														Slightly present.
19	S														
20	F												12. 12 $\frac{1}{2}$		
21	F														
22	S														
23	S												12. 10 $\frac{1}{4}$	120/70	

TABLE XI.



normal, was hardly to be recognized as diabetic, and the subsequent curves which have been obtained have been lower than the average normal. He has shown a marked drop in weight and his blood-pressure has been entirely satisfactory. During the last year his carbohydrate has been increased, and he has had nearly double the amount allowed on the diet. The patient had been at work except for a fortnight throughout the entire period of observation.

Section of Surgery

President—G. GREY TURNER, M.S.

[June 1, 1938]

The Treatment and Prognosis of Tetanus

By LESLIE COLE, M.D., F.R.C.P.

In the treatment of tetanus, efforts should be directed along three lines : (1) The prevention of further absorption of toxin by the central nervous system, (2) the control of reflex spasms, which kill by respiratory spasm, and (3) the maintenance of strength by giving sufficient food and fluid and promoting sleep.

Considerable difference of opinion exists as to the best method of giving antitoxin —whether it should be given intrathecally, by lumbar or cisternal puncture, intramuscularly or intravenously, or whether by all these routes, and whether by repeated doses or by one large dose. It is evident that when the first symptoms appear some toxin has reached the nervous system, and that in most cases more toxin is still, at this stage, being absorbed from the wound. In most patients symptoms will first appear before a lethal dose has been absorbed, so that if further absorption from the wound and circulation can be prevented soon enough, recovery is simply a matter of time. The aim of antitoxin treatment, therefore, is to bring antitoxin in large amounts in contact with toxin as soon as possible after the first symptoms have appeared. Toxin present in the lymph and the blood would seem to be most speedily neutralized by a large dose of intravenous antitoxin.

The next question to consider is whether toxin which has reached the nervous system can be affected by antitoxin and, if so, whether the intrathecal or cisternal routes have any advantage over the intravenous.

Ransom (1903) states that toxin which has reached the nervous system is inaccessible to antitoxin, and there is no convincing evidence to refute this. Even if it were not true, however, it is difficult to see why the intrathecal route should be better than the intravenous. Weed (1932) has shown that the cerebrospinal fluid is absorbed into the venous sinuses and that a small amount passes out along the perivascular spaces to the subarachnoid space. Fluid introduced into the theca will therefore tend

to be reabsorbed into the veins and will not come into close contact with nervous tissue as quickly as if it were injected directly into the veins. Florey and Fildes (1927) compared the two routes in rabbits, using a special technique to ensure that the fluid from the arachnoid space was sucked into the perineurial spaces, but found no advantage with the intrathecal route. The opinions of clinicians vary, but their results are difficult to assess, and different series of cases can be quoted in favour of each method. Taking all the evidence, it is difficult to see what advantage is to be gained by intrathecal over intravenous antitoxin.

The next question to answer is whether one large dose is sufficient, or whether it should be repeated. In an attempt to answer this, Spooner (1935) observed the rate of disappearance of antitoxin in four patients of this series after a single intravenous dose of 200,000 units. He showed that seven days after the injection there are still 50,000 units in the circulating blood or 10 units of antitoxin per c.c., and 3-5 units per c.c. at the end of fourteen days. Since a prophylactic dose of 3,000 units is able to protect in most cases from even a badly infected wound, it would not seem necessary to give a further injection before the seventh day, and by that time the battle is usually won or lost.

After considering the evidence, I decided to give a single dose of intravenous antitoxin, and chose 200,000 units arbitrarily as being sufficiently large to prevent further absorption of toxin from the wound. During the last few years I have reduced this dose in mild cases.

For the control of reflex spasms, avertin, first suggested by Momburg and Rotthaus (1929), has proved very effectual, given as for basal anaesthesia in doses of 0·1 c.c. per kilo body-weight. In severe cases this controls reflex spasms for from three to six hours, relaxing the jaw and making feeding possible. In very severe cases two or three such doses may be given daily for seven days on end without undue risk. Pneumonia is the complication most to be feared, and to lessen this risk nasal oxygen and atropine should also be given. In milder cases, when the reflex spasms are short and infrequent, large doses of bromide, chloral, nembutal, and rectal paraldehyde are all valuable.

The importance of quiet, good nursing, and a full fluid diet, is very great. All manipulation and movement of the patient should be done when he is deeply anaesthetized.

Forty cases¹ have now been treated on these lines, and the results are now briefly considered, with special reference to prognosis :—

Sex.—35 were in males and 5 in females.

Age.—The youngest was aged 6 days and the oldest 75 years.

Incubation period.—It has long been recognized that severity is inversely proportional to length of incubation period. This has been found to be approximately true. Patients with an incubation period of six days or less rarely recover. On the other hand, cases are sometimes much more severe than the apparent incubation period would lead one to suspect. This is partly because infection does not take place at the time of the wound, but later, and is actually shorter than is apparent. It is therefore not a very accurate guide.

Period of onset.—Much more accurate prognostic information appears to be given by measuring the period of time between the occurrence of the first symptom and that of the first generalized reflex spasms. This I have called the "period of onset," and it can usually be accurately measured to within a few hours. In this

¹ 21 previously reported. *Quart. J. Med.*, 1935, new series, 4, 295; *Brit. Med. J.*, 1936 (i), 1191; *Lancet*, 1935 (ii), 246.

series of 40 cases, 21 patients recovered, and of these, 20 had a period of onset of forty-eight hours or more, and only one—a baby—had a shorter period of onset (eighteen hours). Of the 19 fatal cases, only four had a period of onset of more than forty-eight hours, and in all these there were other reasons for death besides tetanus. (Male, aged 31: Pneumonia when tetanus was disappearing. Male, aged 61: Arteriosclerosis and chronic bronchitis. Male, aged 67: Pneumonia. Male, aged 65: Gross arteriosclerosis.) The length of the period of onset in this series appears to be approximately proportional to the amount of toxin absorbed by the nervous system, and forty-eight hours corresponds with one lethal dose.

In fatal cases of uncomplicated tetanus the duration of life is rarely longer than three times the period of onset. In those that recover the severity, as measured by the duration of reflex spasms, bears a more indefinite relationship to the period of onset, but the shorter the period of onset the more severe and prolonged are the symptoms.

Results.—

Total cases 40—

Recoveries 21	Recovery rate 52.5%
Deaths 19	Mortality rate 47.5%

Excluding six patients aged over 60 years, who died :—

Total cases 34—

Recoveries 21	Recovery rate 62%
Deaths 13	Mortality rate 38%

Excluding a further five patients who died within
24 hours of admission :—

Total cases 29—

Recoveries 21	Recovery rate 72%
Deaths 8	Mortality rate 28%

To assess the value of any particular method of treatment it is important to be able to estimate prognosis accurately. In a disease like tetanus, with extreme variation in severity, comparative mortality rates are of little use in comparing different methods unless a comparison is made between cases of similar severity. In this series of 40 consecutive cases treated as far as possible by the same method, an attempt has been made to establish a standard by which different methods of treatment may be compared. For this purpose accurate measurement of the "period of onset" appears to be of value.

REFERENCES

- COLE, L., and SPOONER, E. T. C. (1935), *Quart. J. Med.*, new series, **4**, 295.
- FLOREY, H. W., and FILDES, P. (1927), *Brit. J. exper. Path.*, **8**, 393.
- MOMBURG, F., and ROTTHAUS, E. (1929), *Deutsche med. Wochenschr.*, **55**, 1164.
- RANSOM, F. and MEYER, H. (1903), *Arch. f. exper. Path. u. Pharmakol.*, **41**, 369.
- WEED, L. (1932), *Physiol. Rev.*, **1**, 748.

Bovine Tuberculosis in the Human Subject

By A. STANLEY GRIFFITH, M.D.

ALL members of the medical profession, at one time or another, are asked for advice regarding milk, particularly for children, and it is essential that they should be kept fully informed of the results of bacteriological investigations into the frequency of bovine tuberculosis in man, one of the most serious diseases conveyed by cows' milk. I propose, therefore, to summarize the evidence which shows that ordinary cows' milk, as supplied to households in Great Britain to-day, is not safe, if consumed in the raw state, from the risk of causing tuberculosis, and should receive some form of heat-treatment before being used, especially by infants and children.

It is well known that there are three types of tubercle bacilli concerned in the production of tuberculosis in warm-blooded animals—the human, bovine, and avian types. The three types are readily distinguishable one from the other, not only by their pathogenic effects for certain animals, but also by the way they grow on artificial media.

It does not appear that the avian type of bacillus plays any part in the causation of ordinary human tuberculosis in this country, since it has not been found in upwards of 7,800 cases examined.

Of the two types which cause tuberculosis in man, the human occurs much more frequently than the bovine. The bovine bacillus is, however, far from being the negligible factor in human tuberculosis which in 1901 Koch declared it to be. Up to 1901 it was widely believed that human tuberculosis was in part due to infection from the cow, through milk, and Koch's declaration in that year had the effect of arresting the measures which were gradually being put into force for diminishing the prevalence of bovine tuberculosis among the cattle in this country.

Bacteriological investigations were therefore necessary, and a Royal Commission was appointed, and reported in 1911. Their findings showed conclusively that bovine bacilli could cause all the chief forms of human tuberculosis, including tuberculous meningitis and ulcerative pulmonary tuberculosis. Unfortunately the significance of these findings was not generally appreciated and, later, other considerations—vitamins, the possible immunizing action of bovine bacilli, agricultural interests—again postponed concerted and energetic action against bovine tuberculosis.

In the meanwhile further investigations, which have been practically continuous to the present day, were undertaken for the purpose of determining accurately the relative frequency of bovine infections in the different forms of tuberculosis, at different age-periods and in different regions of the British Isles. The results of these are summarized in the tables (at the end of this paper).

The main conclusions that may be drawn from them are that :—

(1) Bovine bacilli can cause all forms of human tuberculosis.

(2) The incidence of bovine infections is highest in children under 5 years of age. In England, in cervical-gland cases, it exceeds 90%, and in other forms ranges from 28 to 58%. In Scotland, as in England, the highest incidence of bovine infections is in children under 5 years of age. In primary abdominal tuberculosis the percentages for the two countries are about the same, namely 80 and 82%.

(3) These facts—the highest incidence in children, and the high proportion of bovine infections in cases of alimentary tuberculosis diagnosed at autopsies—clearly point to milk as the chief source of the bovine bacilli.

(4) Human tuberculosis of bovine origin is widely distributed throughout Great Britain and is proportionately more frequent in Scotland than in England.

The results of investigating pulmonary tuberculosis during the last twelve years or so have demonstrated beyond doubt that bovine tuberculosis is an even more serious menace than was earlier supposed. In 1908 Koch maintained that up to that year no case of chronic pulmonary tuberculosis in human beings had been shown conclusively to be due to bovine bacilli. A few months later, that is, in February 1909, when working for the Commission, I obtained pure cultures of this type, repeatedly, from the sputum of two men in Brompton Hospital, aged 21 and 31 years, respectively. In 1913 and 1914 two further cases were discovered in Edinburgh, and it was clear that ulcerative pulmonary tuberculosis could be caused by bovine bacilli. Further investigations were interrupted by the War, and no more cases were found until 1922-24, when Munro and his collaborators discovered two among 100 cases of pulmonary tuberculosis examined at Glenlomond (Fife and Kinross) Sanatorium. This finding stimulated renewed researches both in this country and abroad, the results of which have shown that phthisis due to bovine tubercle bacilli is by no means a rare occurrence. The total number of bovine pulmonary cases found in Great Britain is now 194. The third table shows the regional distribution of these 194 cases. It will be seen that the percentage of bovine infections rises from less than 1% in the South of England to 9% in the rural districts of North-east Scotland. Six of the 52 bovine cases from North-east Scotland were found among 19 patients from the Orkney Isles, giving for these islands the astonishingly high percentage of 31.5.

Aetiology, Pathology, and Epidemiology of Bovine Phthisis.—The ages of the patients ranged from 7 to 71 years. There is an interesting, and as yet unexplained, difference in the sex incidence between England and Scotland. In England there is a slight preponderance of males over females, while in Scotland there is a great excess of females over males, the ratio being about five to three.

The occupations of the patients have been diverse, but of interest in this connexion is whether or not the employment brought the person into contact with cattle. Of the 194 persons 38, so far as at present ascertained, were "cattle contacts"; some were farmers or milkers who would be specially exposed to infection, and some were ploughmen and farm labourers whose contact, if any, would be indirect and brief.

Here again there is a difference not yet explained between England and Scotland. Of 22 English "cattle contacts" few drank much raw milk and none gave any indication, so far as clinical evidence goes, of the infection being of alimentary origin. Of 16 "cattle contacts" in Scotland, on the other hand, nearly all were in the habit of drinking daily large quantities of raw milk, and four gave a history of previous tuberculosis—three cervical gland and one Pott's disease.

The duration of clinical tuberculosis from the first appearance of symptoms to the date when bovine bacilli were found in the sputum ranged from a few months up to sixteen years. It has not always been possible to obtain a history which would date even approximately the first appearance of bacilli in the sputum, but in about two-thirds of the cases the disease in its ulcerative stage had its beginning below the age of 25 years in women and 30 years in men.

The extent and character of the pulmonary lesions have shown wide variations, but have not been in any way different from what might be found in the same number of human type cases.

The following are the main facts which have been established by the investigations of pulmonary tuberculosis:—

(1) The bovine type of bacillus can produce ulcerative pulmonary tuberculosis in the human subject, indistinguishable clinically from that caused by the common human bacillus.

(2) The clinical and pathological evidence in about a third of the cases was clearly in favour of the alimentary tract as the portal of entry of the bacilli, the primary infection in most of these cases dating back to childhood or adolescence.

(3) The latent period of bovine phthisis of alimentary origin, that is to say, the period between the probable original infection and the breakdown of the pulmonary lesions, has ranged from less than a year up to 26 years or more.

In illustration of this statement I will give the clinical particulars of four cases:—

I.—A male student, aged 20, had neck glands excised in December 1936. In June 1937 there were clinical symptoms of pulmonary tuberculosis, and in August bilateral central disease—with extension to the whole of the right lung, and much cavitation—was found. Here the latent period was about six months.

II.—A youth, aged 17. At 12, a gland in the neck broke down. Nine months before admission he began to cough; the chest was examined, and both lungs were found to be extensively infiltrated; the larynx also was affected.

III.—A girl, aged 11, with extensive disease of both lungs. She had enlarged glands at 20 months and a continuous history of tuberculosis until she died at the age of 12.

IV.—A man, aged 31, with disease of upper two-thirds of both lungs. Tuberculous cervical glands at 3 years. Clinical symptoms of pulmonary tuberculosis at 29.

(4) Bovine phthisis is of more frequent occurrence in Scotland than in England.

(5) In Scotland the incidence of bovine phthisis is highest in districts where the consumption of raw milk is greatest.

(6) Bacteriological evidence of transmission of bovine bacilli from human case to human contact has been obtained.

(7) One instance is known where it is probable that a farm servant with bovine bacilli in his sputum transmitted infection to dairy cattle.

These results constitute a complete refutation of the assumption that bovine tuberculosis is of little importance to man.

I should now like to refer to some misconceptions regarding bovine tuberculosis in man, which have been current in the past and still prevail in certain quarters. In the first place there is the belief engendered by Koch that the bovine bacillus is less virulent for man than the human bacillus. This opinion I have never shared, and on various occasions I have stated my reasons for disagreeing. The occurrence of tuberculous meningitis and acute pneumonic phthisis—the most fatal of all forms of tuberculosis—due to bovine bacilli alone disproves the hypothesis of a low pathogenicity for man of the bovine type. The demonstration of this fact has fully exposed the danger of the doctrine that a few tubercle bacilli in milk are permissible for their assumed protective action against pulmonary tuberculosis in later life. Our researches have shown, on the contrary, that persons subclinically infected with bovine bacilli in childhood may in later life actually develop ulcerative pulmonary tuberculosis due to these same bacilli, and may spread bovine tuberculosis to other human beings and to animals, through the agency of the sputum.

A further misconception is that bovine bacilli can readily change into human bacilli in the human body. There is no certain evidence that such a change ever takes place. On the other hand there is abundant evidence that these bacilli can retain their characteristic properties during the whole course of a case of tuberculosis. For example, bovine strains typical in every respect, or only slightly below the normal virulence, have been obtained from cases of lupus which had lasted from thirteen to fifty-two years (average of 17 cases, twenty-two years), and from many cases of adult phthisis, the infection dating back to childhood.

In the matter of bovine tuberculosis the people of this country are apparently not disturbed to the same extent as in the more dramatic epidemics due to cows' milk—such as enteric fever and streptococcal infections. This apathy is attributable, no doubt, to the fact that in an epidemic caused by bovine bacilli there is no sudden outbreak

involving a large number of people with more or less the same symptoms. A number of individuals may be infected at the same time by a milk containing tubercle bacilli, but the disease produced will reveal itself in many different forms and after many varying periods of time. Moreover, one cannot say with certainty, without bacteriological examination, whether a case of tuberculosis is due to bovine bacilli or not.

The figures I have given have been ascertained by careful bacteriological investigations and these, taken in conjunction with the great prevalence of tuberculosis in cattle, show the importance of insisting that no milk from reacting cows should be sold for consumption in the raw state or be used in that state for the production of cream or butter.

The wide prevalence of tuberculosis among the dairy herds of the country is shown by the numbers of samples of bulk milk from farms found infective for guinea-pigs; these vary from 1% or 2% up to 18% or more.

There is an increasing consumption of milk as a food. Nearly three million children now take milk regularly each morning on school days and consume, in all, 25 million gallons in a year. A few years ago the People's League of Health ascertained that of 1 $\frac{1}{2}$ million children in elementary schools having milk, 350,000, or 20%, received raw milk from untested cows. The authorities responsible for $\frac{3}{4}$ million children did not reply to the questionnaire, so one can assume that more than 20% are not safeguarded. No child should be given either in school or at home, milk which may produce a fatal or a crippling disease. It would be lamentable if greater consumption of milk, with the object of improving the physique of the nation, should in the end, owing to lack of precautions, increase the frequency of human tuberculosis of bovine origin.

TABLE I.—ENGLISH STATISTICS

Compiled from the Royal Commission on Tuberculosis Reports and Papers published by A. Eastwood, F. and A. S. Griffith, and J. Menton.

Variety of tuberculosis	No. of cases	Percentage of cases infected with the bovine type of bacillus		
		Under 5 years	5-15 years	All ages
Cervical gland	128	91.3	54.2	50.0
Lupus	191	58.4	44.4	48.7
Scrofuloderma	60	53.3	43.3	36.6
Bone and joint	554	29.5	19.1	19.7
Genito-urinary	23	—	—	17.4
Meningeal	265	28.1	24.5	24.6
Autopsies	198	28.6	15.5	22.9
Miscellaneous	23	33.3	9.1	8.7
Pulmonary (sputum)	3,103	—	—	1.4

TABLE II.—SCOTTISH STATISTICS

Compiled from Papers published by J. W. S. Blacklock, A. S. Griffith, W. T. Munro, A. R. Macgregor, H. J. R. Kirkpatrick and W. S. Craig, J. Smith, G. J. Summers and C. Y. Wang.

Variety of tuberculosis	No. of cases	Percentage of cases infected with the bovine type of bacillus		
		Under 5 years	5-15 years	All ages
Cervical gland	95	65.0	63.0	52.6
Lupus	13	100.0	71.4	69.2
Bone and joint	225	45.5	29.9	30.7
Genito-urinary	42	—	—	31.0
Meningeal	203	34.4	14.0	29.6
Autopsies	290	33.6	38.5	32.4
Miscellaneous	17	—	—	64.7
Pulmonary (sputum)	2,371	—	—	5.4

TABLE III.—PROPORTIONAL FREQUENCY OF HUMAN AND BOVINE TYPES OF TUBERCLE BACILLI IN SPUTUM

Country	Region	Authors	No. examined	Human	Bovine	% bovine
Scotland	N. { Rural	Griffith and Smith	409	372	37	9.0
	E. { City	Griffith and Smith	342	327	15	4.4
	Middle	Munro ...	1,057	1,007	50	
	and South	{ Griffith ... Wang ...	534 29	510 28	24 1	4.5
England	North	Cumming ...	888	874	14	1.6
	Middle	Lynn and Cutbill ...	1,000	978	22	2.2
	Middle	Griffith and Menton ...	230	228	2	0.9
	S.E.	Page ...	100	99	1	1.0
	S.E.	Griffith ...	690	686	4	0.6
	South	Cumming ...	195	194	1	0.5
	Various parts	Cumming ...	245	224	21	
Wales	...	Cumming ...	203	201	2	1.0
Eire ...	...	Cumming ...	320	320	—	0.0

NOTE.—These tables differ slightly from those published in *Tubercle*, 1937, 18, through additions to some series, and omission of footnotes.

Section of Therapeutics and Pharmacology

President—J. W. TREVAN, M.B.

[March 8, 1938]

Proferin, a New Diabetic Food

By W. W. PAYNE, M.B.

THERE has recently been introduced a new diabetic flour which is made from the germ of the carob or locust bean (*Ceratonia siliqua*). It is naturally almost free from starch, although some hemicelluloses are present which yield carbohydrate on acid hydrolysis. This protein resembles the gluten of wheat in many of its physical properties, thus enabling it to be used in bread- and biscuit-making.

Experiments showing that vegetable proteins have less effect than animal proteins on the blood-sugar level have been made by Von Noorden (1927) and others, but the general view has been that not a great deal of difference exists between proteins from various sources, with regard to the effect on the blood-sugar. More positive claims are made by Egedy (1933) in respect of the new vegetable protein. He asserts that it has in most cases no effect on the blood- and urine-sugar, and that in the least favourable cases it has considerably less effect than any animal protein.

Since more palatable foods can be prepared with this new protein flour than with the starch-reduced diabetic flours hitherto available, it was considered worth while to investigate its properties. The result of this investigation, so far as it has gone, is largely to substantiate the claims made by Egedy.

Experiment I.—Five diabetics who were known to be reliable and were in a state of equilibrium, were each given, for a period of two to four weeks, about 3 oz. of various Proferin biscuits and cakes per day as an addition to their usual diet. This would cause an addition of about 4–5 grm. of carbohydrate, 18–22 grm. of protein, and 18–22 grm. of fat daily. The urine was tested at home and the blood-sugar was estimated at weekly intervals at the same time of the day. Table I gives the results.

TABLE I.—EFFECT ON THE BLOOD-SUGAR OF PROFERIN ADDED TO THE DIET, THE READINGS BEING TAKEN WEEKLY AT THE SAME TIME OF THE DAY.

Case	Age	BLOOD-SUGAR %					Effect on urine-sugar
		Before Proferin	During Proferin feeding			After Proferin	
			1st week	2nd week	3rd week		
A. R.	16	.088	.077	.077	.070	.088	No change
J. T.	12	.220	.260	.170		.147	No change
L. S.	8	.097	.083	.100	.082	.118†	No change
T. L.	11	.158	.170	.115	.085*	.254	1st week a little more sugar 2nd - 4th weeks, no change
					.146	.145	
R. B.	10	.246	.210	.202		.175	Was passing too much sugar for small differences to be detected at home.
						.228	

* Extra exercise just before blood was taken.

† Has a cold.

It will be seen that the extra food made no apparent difference to the blood-sugar in any case.

Experiment II.—Case R. G. was given the following meals while fasting in the morning. He was receiving protamine zinc insulin, and the previous day's dose accounts for the very low fasting value of the blood-sugar. Some rise in the blood-sugar during the next three hours would be expected even without food, but owing to early symptoms of hypoglycaemia it was not possible to investigate this point.

MEAL 1.—2 oz. Proferin biscuits and 3 oz. butter (=22 grm. protein).

MEAL 2.—1 egg, 1 oz. bacon, 2 oz. haddock (=21 grm. protein).

MEAL 3.—2 oz. bread and $\frac{1}{2}$ oz. butter.

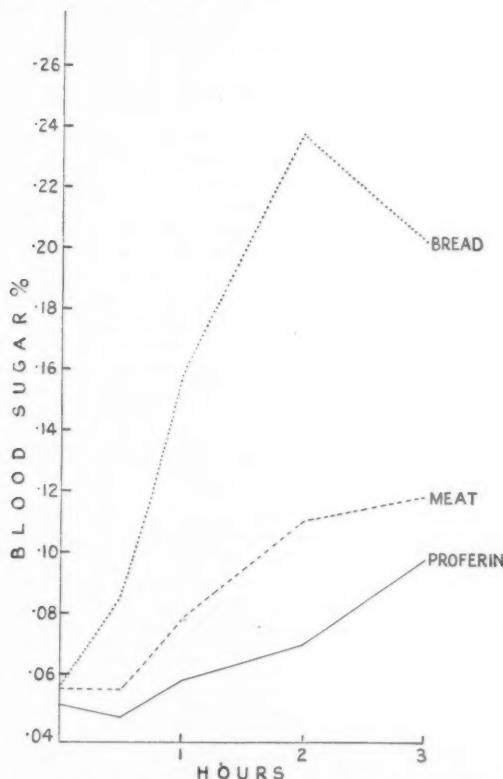


FIG. 1.—Showing the effect on the blood-sugar of meals containing equivalent amounts of (1) Proferin protein, (2) animal protein, (3) bread.

It will be seen from fig. 1 that the meat and fish protein caused a greater rise in the blood-sugar than the Proferin protein.

Experiment III.—Four diabetic children in the hospital were given, as an addition to their diet for four-day periods :—

(1) 1 oz. Proferin cake, 1 oz. Proferin biscuit, and 1 oz. Proferin rusks. These contained 23 grm. protein, 13 grm. fat, and a little carbohydrate—about 5 grm.

(2) 2 oz. meat plus 1 oz. sardines, containing about 23 grm. protein and 14 grm. fat.

The daily blood-sugar at 12 noon and the total output of sugar in the urine, before, during, and after each diet period, were estimated. The nitrogen output was estimated also, but such considerable variations were found in each of the periods that no reliance could be placed on the values, but Proferin protein did cause a definite increase in the urinary nitrogen.

Case F. E. showed no rise in the blood-sugar until the fourth day. The blood-sugar continued to rise even after stopping Proferin feeding. On the seventh day his nose was swabbed because of discharge, and virulent diphtheria bacilli were grown, thus accounting for the rise of the blood-sugar.

Case G. W.—This child was sugar-free until two days before the test was started. Almost at once he began to excrete large quantities of sugar, much greater than the maximum which could be obtained from the protein. Equilibrium was not regained for some time, and only after extra insulin had been given. The experiment apparently coincided with an exacerbation of the diabetes.

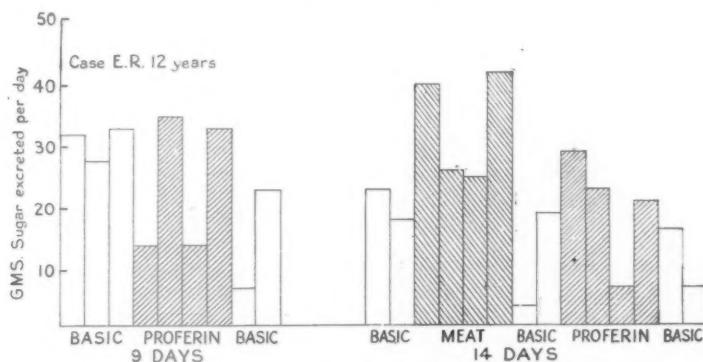


FIG. 2.—Showing the daily sugar excretion on (a) basic diet, (b) basic diet + Proferin diet, (c) basic diet + animal protein.

Case E. R.—Here there was only a slight increase in the sugar output on Proferin (17.9 grm. of glucose average per day for ordinary diet, and 21 grm. on Proferin) which might be due to the few grm. of carbohydrate in the food. With animal protein feeding, however, there was a definite increase in the sugar output (15 grm. per day on ordinary diet against 32 grm. with extra protein), see fig. 2.

Case R. G.—Here the first period on Proferin gave, as with E. R., a small rise in the sugar output and a rise in the blood-sugar. The animal protein feeding, however, was followed by a large and prolonged rise, as in Case G. W., except that after nine days the daily output fell to about 10 grm. only, but not until the insulin was raised was the child sugar-free again.

A second Proferin period showed a similar result to the animal protein period, and a third Proferin period an increased output of about 14 grm. of sugar per day occurred, but the rise was not prolonged beyond the period of the experiment.

On a subsequent admission it was discovered that this child had periods when he did not keep to his diet. However, in the first and third Proferin periods the excretion fell at once to the original level and the results are presumably reliable.

Discussion.—Experiment I is quite definitely in support of the view of Egedy, as also is Experiment II.

In Experiment III, in only one case (E. R.) can the results be relied on. There the Proferin protein produced a smaller rise in the sugar excreted than did the corresponding amount of animal protein. In Case R. G. two periods were reliable, and in them the Proferin protein caused a small but quite definite rise in the sugar excretion. Averaging both periods, 23 grm. of Proferin protein per day caused an excretion of 5 grm. of carbohydrate a day, after allowing for the 5 grm. of carbohydrate included in the Proferin meal.

TABLE II.—EFFECT ON THE DAILY BLOOD-SUGAR ON THE ADDITION OF EXTRA PROTEIN
(a) AS PROFERIN ; (b) AS MEAT AND FISH. READINGS TAKEN AT NOON.

Case		Before	Daily Blood-sugar %—Noon	After
<i>F. E., 13 years</i>				
Proferin		.120	.180	
Protein		.085	.114 .093 .140 .165	.180 .190 .308
				Diphtheria detected
<i>G. W., 10 years</i>				
Proferin		.266	.400	.260
Protein		.205	.390 .400	.280 .290*
<i>E. R., 12 years</i>				
Proferin		.177	.170	.106
Protein		.196	.197	.150
Animal		.120	.264	.186
Protein		.130		.177
Proferin		.186	.160	.220
Protein		.177	.134	.140
<i>R. G., 8 years</i>				
Proferin		.058	.085	.053
Protein		.070	.126	.076
		.091	.099	
Animal		.053	.100	.150
Protein		.076	.146	.088
			.086	
Proferin		.140	.140	
Protein		.183	.255	.234†
Proferin		.098	.112	.256
Protein		.083	.164	.167†
			.200	

* The experiment coincided with an exacerbation of the diabetes.

† It was subsequently discovered that the child did not keep to his diet.

Summary.—The addition of Proferin protein to the diet of a diabetic in some cases has no effect on the blood- or urine-sugar. In other cases it causes a small increase in the sugar excretion, but this is less than that produced by a corresponding amount of animal protein. This new protein may therefore be regarded as a useful supplementary food for diabetics.

[I wish to thank Dr. W. Pearson and Dr. E. A. Cockayne for allowing me to investigate children in their care.]

REFERENCES

EGEDY, E. (1933), *Hungarian Medical Review*, **49**.
VON NOORDEN, K. and ISAAC, S. "Diabetes and its treatment", 8th Ed., Berlin, 1927, p. 130.

DISCUSSION ON THE VALUE OF ZINC PROTAMINE INSULIN IN TREATMENT

Dr. R. D. Lawrence: In judging the value of zinc protamine insulin as compared with other types of insulin, it is important to adapt insulin injections in diabetics to imitate as nearly as possible the natural secretion of insulin in normal individuals. In the latter my own view is that there is (1) a small continuous secretion of insulin from the pancreas which controls endogenous sugar production, and (2) an added secretion of insulin after carbohydrate meals to deal with the ingested sugar. Such a double function cannot at present be imitated exactly by any commercial insulin preparation.

The length of action, the type of action, and the times of probable hypoglycaemia in the three types of commercial preparations are shown in the accompanying table.

Type of insulin	In doses (Units)	Duration of action (Hours)	Commonest time of hypoglycaemia (Hours)	Type of action
Soluble	Up to 10	5-6	2-4	Quick and strong Balances much carbohydrate
	" 20	6-8	3-5	
	" 40	10-12 (with large doses)	6-8	
Retard	" 20	8-10	4-6	Slower Balances less carbohydrate
	" 40	12-16	6-9	
	" 60	Occasionally 24	7-12	
Zinc protamine insulin	" 10	6-8	5	Very slow Balances carbohydrate poorly
	" 20	12	8-12	
	" 30	18-24	8-20	40 units 24 hours (or longer) (or more)
			16-24	

From this it will be deduced that zinc protamine insulin is the only preparation given in one daily dose which can be used in sufficient dosage to exert an influence for twenty-four hours without inevitably causing hypoglycaemia.

With regard to the use of one dose of zinc protamine insulin a day to control insulin cases : In mild cases, such as those previously requiring some 10-15 units twice a day of soluble insulin, this control is easy : About 20-30 units can be given before breakfast and the diabetes can be almost ideally controlled. This is the easiest and most successful form of treatment for the practitioner, and ought to make the use of insulin more widespread and successful.

More severe cases, requiring some 40-60 units a day, are not well controlled by such moderate, or even larger, doses of zinc protamine insulin given once a day, as less insulin is liberated at any one moment than is necessary to deal with severe insulin deficiency. In such cases I would advocate the addition of some 10-20 units of soluble insulin before breakfast, and in the same syringe. Still more severe cases require the addition of a second dose of soluble insulin in the evening to control the diabetes sufficiently to prevent ketosis and ensure health.

Dr. R. S. Aitken : A year ago, when zinc protamine insulin first came on the English market, it was a little difficult to decide how best to use it. Various statements were made about its duration of action and time of maximal action. Some workers gave it in the morning, some in the evening. Dr. Lawrence [1] wrote that moderate doses continued their action for twenty-four hours, larger doses even longer. Dr. Izod Bennett [2] and his colleagues, on the other hand, were "unable to confirm the suggestion that cumulative effects might occur", i.e. the prolongation of action beyond twenty-four hours. Some careful observations were therefore made on a few patients in order to determine the duration of action of different doses of the substance. For this purpose the rate of sugar excretion in three-hour periods, on a constant intake of

food, was measured. This was regarded as more informative than blood-sugar estimations ; the latter record merely the level of sugar in the blood resulting from combined variations in the rate of entry of sugar from gut and liver and in its rate of exit into the tissues, the liver, and the urine, while the measurement of sugar excretion on a constant intake reflects the amount of sugar metabolized by the body. Observations were made on four patients, aged respectively, 11, 13, 17, and 17, all diabetics of moderate severity. Diets were given containing 240-400 grm. of carbohydrate. The duration of action of a given dose of zinc protamine insulin was taken as the time from the injection till either (a) the return of the glycosuria to its pre-injection level, or (b) the reappearance of acetone in the urine. The two methods gave closely similar results. The main findings were as follows :—

(1) The duration of action of zinc protamine insulin in a given patient varies roughly with the dose. The shortest duration observed was fifteen hours after 15 units in a boy aged 11 ; the longest was sixty hours after 60 units in the same boy, and after 100 units in a boy aged 13.

(2) A given dose would exert its action for different lengths of time in different patients.

(3) Injection of a given dose in several fractions, given simultaneously at several different sites, caused some shortening in its duration of action.

(4) In many instances, with suitable doses, glycosuria would drop from a high level to zero within from three to six hours of injection of zinc protamine insulin, and after returning some time later, would gradually climb to its original level.

These findings can be most easily explained by supposing that local factors of solubility and circulation determine the rate of release of zinc protamine insulin from the site of injection into the general circulation, whence it can reach the tissues and exert its action at once. It is likely that the rate of release, and therefore the amount of action exerted, rise rapidly to a maximum within a short time of injection and thereafter gradually diminish. If that is so, the optimum time for giving the substance to diabetics is clearly early in the morning, and a moderate or large dose so given may be expected to continue to exert some action after twenty-four hours—or even after forty-eight hours—thus overlapping with subsequent morning doses. Moreover, the carbohydrate intake should be distributed as widely as is convenient over the twenty-four hours, and should be highest in the forenoon, diminishing gradually throughout the day. In practice these suggestions work well in some cases, but there are others in which glycosuria behaves erratically for no obvious reason, and hypoglycaemia occurs unexpectedly. Irregular absorption of zinc protamine insulin from the site of injection may explain—or partly explain—these cases, and occasionally the irregularities are so great as to force a return to treatment solely with soluble insulin.

REFERENCES

1 LAWRENCE, R. D., and ARCHER, NOBA, *Brit. M. J.*, 1937 (i), 487.

2 BENNETT, T. IZOD, DAVIE, T. M., GAIRDNER, D., and GILL, A. M., *Lancet*, 1937 (i), 1319.

Section of Epidemiology and State Medicine

President—Sir ARTHUR MACNALLY, K.C.B., M.D.

[May 27, 1938]

The Incidence of Tonsillectomy in School Children

J. ALISON GLOVER, O.B.E., M.D., F.R.C.P., D.P.H.

THE rise in the incidence of tonsillectomy is one of the major phenomena of modern surgery, for it has been estimated that 200,000 of these operations are performed annually in this country and that tonsillectomies form one-third of the number of operations performed under general anaesthesia in the United States. There are, moreover, features in the age, geographical and social distribution of the incidence, so unusual as to justify the decision of the Section of Epidemiology to devote an evening to its discussion.

HISTORY

It seems unnecessary to review the history of operative treatment of the tonsil, and I will confine myself to pointing out that while it was natural that, in pre-anaesthetic and pre-Listerian days, the incidence of operation should be very small, it is astonishing to find how recent is the great vogue of the operation. For many years after the introduction of anaesthesia and aseptic surgery the incidence remained low. In 1885 that great physician Goodhart [14] said, "It is comparatively seldom that an operation is necessary, and fortunately so, for parents manifest great repugnance to it. Children grow out of it, and at 14 or 15 years of age the condition ceases to be a disease of any importance". These words were repeated in several subsequent editions.

In 1888 I went to a preparatory boarding school of 50 boys, and then, in 1890, to a public school of 650 boys. Though, as the son of a doctor and destined for the profession myself, I took some interest in medical matters even then, I cannot recall a single boy in either school who had undergone the operation. Both schools still flourish, but the percentage of tonsillectomized boys is now in both alike about 50%, and, as we shall see later, even this is nowadays a low figure for schools of these types.

Old photographs reveal little difference in appearance between the untonsillectomized fathers and the tonsillectomized sons, and although the latter seem to grow taller and heavier than we did, memory suggests that we were at least as resistant to infection.

EARLY ESTIMATES OF THE NEED FOR OPERATION

It is difficult to estimate the number of operations previous to the introduction of the School Medical Service. Any such estimate is derived either from estimates of the number of children whose tonsils are said to "require immediate operation" or from hospital records.

In 1903 the Report of the Royal Commission on Physical Training (Scotland) gave the age-and-sex grouped results of the examination of 600 Edinburgh and 600 Aberdeen school children, in tables, which showed well the two periods of physiological

enlargement. The total percentages of children¹ with enlarged tonsils are in Edinburgh, 30.3, and in Glasgow, 21.2. All enlargements, however slight, are included. "About one-fifth to one-fourth, that is about one in twenty, of all the children examined would probably have benefited by surgical treatment".

Thus some 6% in Edinburgh and 4% of the Aberdeen children were thought probably to require operation. The high figures for the girls at puberty suggest that many cases of physiological enlargement have been included. By way of contrast, twenty-eight years later, i.e. in 1931, the School Medical Officer for London [21], stated that more than 33% of London elementary school children had been operated upon by the time they left school at 14 years.

This London figure of over 33% is much the same as the mean (32%) of the Edinburgh and Aberdeen children at age 12-15, but whereas in 1903 it was thought that only one-fifth of this 32% would probably have benefited by operation, in 1931 more than 33% of London elementary school children had actually been operated upon.

HOSPITAL RECORDS

Before dealing further with records from the School Medical Service, I turn to those from hospitals. T. Jefferson Faulder [11] in 1910 estimated that in twenty-five London "institutions" 23,979 operations were done in a year. He points out the difficulty of estimation arising from the fact that, at that time, and, indeed, up to comparatively recent years, many tonsil operations were performed in out-patient departments, for which incomplete or no records have been kept. Latterly a fuller appreciation of the risks of the operation, risks repeatedly emphasized by the Board of Education, has caused most authorities to arrange for admission of all patients. Thus Mr. P. B. Ashcroft tells me that, at the Middlesex Hospital in 1927, there were 586 tonsil operations on children, all in the out-patient department. In 1937 there were 352, all on children admitted as in-patients.

The following very incomplete table suggests the rapid rise in vogue of the operation at the beginning of the twentieth century, the comparative slackening during the War years, the high tide of 1931, and the subsequent ebb.

For the information therein I am greatly indebted to Dr. G. Ewart Martin and Miss R. McGlashan as regards the Royal Infirmary, Edinburgh; to Dr. P. Mallam and Mr. A. G. E. Sanctuary as regards the Radcliffe Infirmary, Oxford; to Dr. J. Paterson and Mr. D. Owen Davies as regards the Hospital for Sick Children, Great Ormond Street; to Mr. P. B. Ashcroft for the numbers at the Middlesex Hospital.

TABLE I.—RISE AND FALL IN THE NUMBER OF OPERATIONS AT CERTAIN HOSPITALS.

	Royal Infirmary, Edinburgh	Radcliffe Infirmary, Oxford	Hospital for Sick Children, Great Ormond St.	Middlesex Hospital
1895	21			
1897		14		
1907	792	235		
1911			1,819	
1917	1,381	352		
1927	2,923	610		586
	(including 728 out-patient)			(all out-patients)
1931			4,019	
1932			3,619	
1933			3,666	
1934			3,378	
1935			3,058	
1936			2,968	
1937	2,046	990		352
	(including 475 out-patient)			(all in-patients)

¹ Compare 33.4% London children, Thorne-Thorne, L., *B. M. J.*, 1904, April 9; 39.5% Leith children, W. Robertson, *ibid.*, 1907, February 23.

RECORDS FROM THE SCHOOL MEDICAL SERVICE

The School Medical Service first became general in 1907, and was naturally confined in its early years mainly to inspection. The provision of treatment gradually followed and grants in aid of treatment having been first paid by the Board of Education in 1914, it was made compulsory in 1918. Full statistical returns of treatment are available from 1923.

In pre-War years emphasis seems to have been laid rather upon the incidence of adenoids than of tonsil conditions.

The rising tide of incidence.—After the War, during which there was a lull, a rapid rise to a peak in 1931 took place. This is shown in Table II.

TABLE II.—NUMBER OF TONSILLECTOMIES OFFICIALLY RECORDED ANNUALLY IN PUBLIC ELEMENTARY SCHOOL CHILDREN FOR LONDON AND ENGLAND AND WALES RESPECTIVELY.

	London	England and Wales
1919	11,817	42,004
1920	—	55,293
1923	7,656	47,685
1924	8,051	49,436
1925	12,179	60,871
1926	13,165	68,250
1927	14,843	80,548
1928	17,372	92,171
1929	17,186	97,518
1930	18,119	109,738
1931	18,178	110,289
1932	15,558	95,875
1933	11,436	77,564
1934	9,715	73,259
1935	9,959	73,763
1936	9,937	80,676
1937	10,198	84,414

In some of the early years of the School Medical Service it had seemed necessary to recommend further provision for the operative treatment of tonsils, but the tide rose so fast that in his Annual Report for 1923, Sir George Newman [17] issued the first of his many warnings against premature resort to operation. During that year nearly 48,000 tonsillectomies were performed upon elementary school children, the children operated upon forming 0·9% of all children in average attendance. Notwithstanding this warning, repeated almost every year, and reinforced by a memorandum from the Section of Laryngology of the Royal Society of Medicine, the number of operations mounted steadily until, in 1931, more than 110,000 operations were performed, i.e. on 2·2% of the children in average attendance. In his Annual Report for this year (1931, p. 50) Newman strongly urged a more conservative attitude towards operation, pointing out that as the normal school life of an elementary school child is nine years—from 5 to 14—the percentage subjected to the operation at some stage of their school life is much greater than the percentage in any one year. Indeed if the annual percentage were to remain constant, the percentage of children who undergo the operation at some time during their school life would be about nine times the annual percentage.

This strong admonition, combined with the work of Tilley [27], Paton [25], Layton [20], Warwick James [19], Bradley [2], Wilson [13], and others in this country, and of Cunningham [6] in America, together with the courageous example of Ash [1] in Derbyshire, exerted a definite influence upon medical opinion.

A considerable fall in the operation rate ensued in 1932 and continued until 1935 in England and 1936 in London. The rate is, however, now rising once more.

Sex incidence.—More boys are operated upon than girls. This fact appears in all series to which I have had access² and in which the sexes are given separately. Thus at the Cyril Henry Treatment Centre of the London County Council, Dr. C. J. Thomas tells me that 647 boys and 554 girls were operated upon in 1937.

In Minnesota, of 1,328 high-school students (11–20 years) 41·3% of boys and 33·3% of girls were tonsillectomized (Hewitt [18]). In English public boarding schools the present proportion is 58·2% of tonsillectomized boys and 50·1% of girls.

When it is remembered that (1) the incidence of acute tonsillitis in female children under 10 seems equal to or greater than that in male children in hospital patients (H. G. Close [4]), (2) the incidence of sore throat in girls in boarding schools is somewhat higher, and (3) the incidence of acute rheumatism in elementary school-girls is much higher than in elementary schoolboys, the lower incidence of tonsillectomy upon girls appears somewhat strange. The sex incidence of the operation seems worthy of more attention than it has received.

Age incidence.—This subject was admirably presented by T. Jefferson Faulder [11] in 1910. Paterson and Bray [24] in 1928, and E. M. Dearn [8] in 1930 also dealt with it, the first in children operated upon in the Hospital for Sick Children, Great Ormond Street, and Dearn in 1,002 children at the School Clinic, Newcastle-upon-Tyne. On the whole, however, the subject has received less attention than it merits, for although the function of the tonsil is unknown, its two periods of physiological enlargement, and its atrophy after puberty suggest that the age at which operation takes place may be of great importance in the result.

Many attempts to assess the after-effects of tonsillectomy lose much of their value, because they give no precise information as to the age of the children at operation. No "control" is of value unless the ages are the same as those of the operated children.

Table III gives the percentage age distribution in four series hitherto unpublished, for which I am indebted severally to Dr. J. N. Deacon, Dr. C. J. Thomas (for two), and Dr. J. Ferguson. Surrey seems to have a later age distribution than London, and the Woolwich girls, as they have a lower incidence, so have they a later age distribution, than Woolwich boys.

TABLE III.—PERCENTAGE AGE DISTRIBUTION.
Incidence of Tonsil Operations.

Author	...	J. N. Deacon	C. J. Thomas	C. J. Thomas	J. Ferguson
Date	...	1932	1937	1937	1937
Hospital or School Clinic	Redbill County	London C.C.	London C.C.	S.C. Woolwich	Surrey C. S.C.
	Middlesex	boys	girls		
Number of children = 100	200	647	554		1,883
1 year	...	—	—		0·1
2 years	...	—	—		0·2
3 "	...	2	2·8	3·2	1·9
4 "	...	9	11·1	8·7	3·7
5 "	...	10	19·9	17·7	12·8
6 "	...	25·0	17·0	15·9	24·7
7 "	...	16·5	16·8	16·8	17·4
8 "	...	15	9·9	9·4	14·5
9 "	...	8·5	7·0	4·9	7·8
10 "	...	2	4·9	5·1	4·5
11 "	...	5	4·6	8·3	4·1
12 "	...	2·5	1·5	3·4	5·0
13 "	...	6·5	3·1	5·1	2·1
14 "	...	2·5	1·1	1·6	1·1
15 "	...	1·5	—	—	0·2
Over 15	...	—	0·2	—	—

² Dr. W. Norman Pickles, M.O.H., of Aysgarth R.D.C., whose masterly paper on "Epidemiology in Country Practice" before this Section in 1935, *Proceedings*, 28, 1337 (Sect. Epid., 37), will be remembered, has, however, been good enough to examine the children in four Council Schools in isolated villages in Wensleydale, and found in the total school population 3% of the boys and 7% of the girls tonsillectomized—a total rate and not an annual rate, be it noted. These figures are remarkable not only because they are low, but in that the girls have more than twice the proportion tonsillectomized than the boys. In a secondary school he found 16% of the boys and 18% of the girls tonsillectomized.

In these new series, as in the old to which I have referred, there is a period of the highest incidence between 5 and 7 years. This period in the life-history of a child is a time of great change alike in his oral cavity and in his general development. His environment also changes, and instead of the familiar "herd" infections of the home, he encounters for the first time the many varied infections of the much larger "herd" of school. That so great a proportion of tonsillectomies should be performed during such a period seems to raise questions of importance.

FUNCTION AND PHYSIOLOGICAL ENLARGEMENT OF THE TONSIL

If, as some believe, the tonsils have a protective function, "absorbing small numbers of organisms and so establishing immunity by gradual dosage" (I. Griffith [15]), the child's entry to the new environment of school might seem the time when they are most likely to be useful.

"To me", says L. W. Dean [7] "it is certain that the tonsils in infancy and early childhood are part of the defence mechanism of the body. They protect the organism against those factors which cause them to become acutely swollen."

If so, it may be that the fate of some tonsils is as unjust as that of Llewellyn's hound Gelert. If, again, there be a period of physiological enlargement of the tonsil between 4 and 6 years, such an age distribution of operation seems, *prima facie*, open to question.

Is it not possible that many of the operations performed at this age of rapid development remove tonsils which are enlarged physiologically or in response to their protective function? May not some of the improvement ascribed in such cases to tonsillectomy be really due to physiological changes which normally take place at this stage in the child's life—the critical age of 7 according to Hippocrates. Later authorities, e.g. H. A. Harris [16], regard it as one of transition from the second "springing-up" period, which ends at 7, to the beginning of the second "filling-out" period from 8 to 10 years.

The fact that in the inquiry [26] into the "catarrhal child", the "unselected" control children showed a higher percentage of enlarged tonsils and adenoids than did the "catarrhal" children seems to support the theory that some physiological enlargement of the tonsil occurs between 4 and 6 years.

But to the many—parents or practitioners—to whom enlargement at any age seems always pathological, a study of the work of K. H. Digby [8A], or that of Cunningham [6] on female students in California University may be commended, or of that of E. Neuber [23] in Hungary, who found that in the lower forms of elementary schools children with "hypertrophic" tonsils had a greater average height and weight than those with "normal" tonsils.

Ellis and Russell [9] recently have given us a new and much-needed view of the value of the tonsil.

Speaking of the 4,000 Basque children who had come out of siege conditions and terrible overcrowding to Southampton they say:—

"Another revealing feature of the group was the appearance of the children's throats. Less than 2% had had tonsillectomies performed, and in a very great number of cases the tonsils were as large or larger than walnuts. But the incidence of both cervical adenitis and otorrhoea was only approximately 0·4%, and that of obvious respiratory infection almost incredibly low. The same is true of nasal discharges and respiratory obstruction. The important question arises as to what will happen to these children now they have reached England. Owing to the difficulty of obtaining parents' consent to operation, it is devoutly to be hoped that they will retain their tonsils, since it might well prove disastrous if these were to be removed before the children had had opportunity of acquiring general immunity to catarrhal infections. (It is also perhaps of interest that of the 200 adults examined none showed appreciably enlarged or unhealthy tonsils.)"

The present early age distribution of operation has been criticized by Layton [20], and more recently I. M. Epstein [10] has convincingly shown that, even in the most carefully selected series of cases, much better results were obtained in children between 6 and 10 years, than in children under 6.

GEOGRAPHICAL DISTRIBUTION

Abroad

The incidence of operation seems to be quite as high in the United States generally as in this country.

In Minnesota [18], of 1,328 high-school students (11–20 years), 41·3% of the boys had had their tonsils removed, the corresponding figure for the girls being 33·3%. Collins [5] found that 61% of the children, from 10–14 years, of medical officers of the Army, Navy, and public health services, had been tonsillectomized, while Cunningham [6] found that one-third of 12,530 young white women students who entered the University of California between 1920 and 1929 had had an operation for the removal of tonsils; one-third were thought to have normal tonsils, and the remaining one-third had "pathologic" tonsils, including remnants of tonsils or buried or projecting tonsils.

But even in the States there are contrasts, and in the country districts of south-eastern Missouri only 2% of school children were tonsillectomized in 1931. In 1932 Dr. Gustav Seiffert, the then medical officer of health for Munich, told me that in that city not more than 0·5% of secondary school children had been tonsillectomized, whilst in the country districts around hardly any children had had the operation.

England and Wales

The Reports of the Chief Medical Officer as early as 1912 (p. 44) showed the great local variations in the proportion of children recommended for operation. As the provision of treatment has been increased, these variations have not diminished but increased. As it is not possible to obtain the proportion of tonsillectomized children in an area by other means, the number of children operated upon in each area in a year, expressed as a percentage of the children in average attendance in that area, forms a convenient index wherewith to compare the geographical variations in incidence. Both figures are approximately accurate. To estimate roughly the total proportion of children tonsillectomized during their elementary school life (i.e. from 5–14 years) this annual incidence rate x may be multiplied by nine. Assuming that the annual rate remains fairly constant (as we shall see it does) this product ($x \times 9$) will be roughly comparable to the proportion of tonsillectomized children found on entry at 14 to public boarding schools, of which more hereafter.

The annual incidence rate for elementary school children in England and Wales in 1923 was 0·9%; in seven years it more than doubled, and in 1930 and 1931 was 2·2%. Comparisons of some of the rates in different areas in 1931, the peak year of incidence, revealed striking contrasts in areas apparently somewhat similarly circumstanced. Thus in that year the operation rate in Margate was eight times that in Ramsgate; that of Enfield was six times that of Wood Green and four times that of Finchley; that of Bath five times that of Bristol; that of Guildford four times that of Reigate; that of Salisbury three times that of Winchester.

For the year 1936 the operation rates for all local education authorities in England and Wales were tabulated for comparison.

For comparative purposes it would no doubt be better to use an average rate for several years, rather than the rate for a single year. This would, however, have much

increased the work, and as the rates generally remain relatively constant in most areas, the disadvantage of a single year rate is less than might be anticipated. A large or sudden change usually denotes a change of medical officer—occasionally, increased facilities for operation.

Table IV shows this relative constancy by comparing the single year rate for 1936 with the average of the rates for the five years 1932-36 in ten areas of different type, six with rather high rates, and four with rather low rates. In only two is the difference significant, or sufficient to change the colouring of the area one degree on the maps which I show.

TABLE IV.—COMPARISON OF 1936 RATE WITH AVERAGE OF RATES FOR THE FIVE YEARS 1932-36.

Area	1936 rate	Average of rates 1932-36
Sussex W.C.	2.4	2.5
Hampshire C.	1.0	1.0
Rutland C.	5.1	5.0
Cambridge C.	0.3	0.3
Oxford C.B.	3.1	2.2
Cambridge B.	1.0	1.7
Royal Tunbridge Wells B.	4.0	3.4
Margate B.	2.5	2.2
Ramsgate B.	0.5	0.5
Enfield U.D.	4.0	3.8

An Examination of the Rates in 1936.

For all England and Wales, the average was 1.7%. In the English Counties (excluding London) the average was 1.5%; for the English County Boroughs it was 1.7%; for English Boroughs 1.8%; for Urban Districts 2.0%; for London 2.2%. In Wales the averages for the Counties and for the County Boroughs were the same as for the English Counties and County Boroughs. The Welsh Boroughs gave a percentage of 2.2, but the Urban Districts only a percentage of 1.5.

In each of these categories there are extreme variations in the operation rate, the extremes often being in adjacent areas. As regards England, these rates have been examined to see whether correlation could be obtained with any factor which might have some aetiological bearing on chronic tonsillitis and adenoidal growths—such factors for example as overcrowding and unemployment. Other possible factors, such as the efficiency of the school dental service, rainfall, climate, and nutrition returns have been considered, but with one extremely doubtful exception—urbanization—not the slightest suggestion of correlation has been obtained. Urbanization, which for many years has been suspected as a factor, seems at first sight suggested by the County Boroughs having higher rates than the Counties, and London a higher rate than the aggregate County Boroughs. But if urbanization be a factor there are inexplicable anomalies, for the Boroughs and Urban Districts have higher average rates than the County Boroughs, the highest rates of all are in certain agricultural counties, and the Boroughs which have the higher rates include residential towns and health resorts famed for their beauty, climate, and spaciousness.

The following shows areas with exceptionally high rates in descending order :—

More than Three Times the Average Rate

Soke of Peterborough, 5.8; Rutland C., 5.8; Blyth B., 5.7; Wrexham B., 5.7; Abertillery U.D., 5.5; Bexhill B., 5.5.

Areas with More than Twice the Average Rate

Colne B. 4.2; Huntingdon C., 4.1; Leicester C.B., 4.1; Carlisle C.B., 4.0; Beverley B., 4.0; Tunbridge Wells B., 4.0; Enfield U.D., 4.0; Hebburn

U.D., 4·0 ; Folkestone B., 3·9 ; Poole B., 3·8 ; Royal Leamington Spa B., 3·8 ; Pembroke B., 3·8 ; Guildford B., 3·7 ; Pudsey B., 3·7 ; Rawtenstall B., 3·7 ; Exeter C.B., 3·6 ; Loughborough B., 3·4 ; Hastings C.B. 3·4 ; Leigh B., 3·4.

On the other hand 4 Counties, 4 County Boroughs, 11 Boroughs and 1 Urban District (this latter having a school population of 23,000) have rates *less than one-third of the average*, while in addition to these 3 Counties, 5 County Boroughs, 17 Boroughs and 2 large Urban Districts have rates *less than half the average*.

The school population in London and Greater London is so vast that I give their rates in full :—

Hornsey, 0·2 ; Wood Green, 0·4 ; Finchley, Edmonton, and Gravesend, 0·6 ; Acton and Walthamstow, 0·8 ; Leyton, 1·2 ; Hendon, 1·3 ; Beckenham, Richmond and Erith, 1·4 ; Kingston, Ewellford, and Chiswick, 1·5 ; Heston and Isleworth, 1·6 ; West Ham and Twickenham, 1·8 ; Penge, 1·9 ; London C., 2·2 ; Barking, Croydon, East Ham, and Wimbledon, 2·3 ; Willesden, 2·7 ; Tottenham and Bromley, 3·3 ; Enfield, 4·0.

Neighbouring County rates are Middlesex, 1·0 ; Essex, 1·6 ; Herts and Surrey, 2·2.

Here are two large coloured maps [not reproduced], one showing rates in County areas, the other rates in the areas of all other Local Education Authorities. Epidiascope maps are also shown : (1) Greater London, (2) areas round Birmingham, (3) part of Lancashire, (4) Tyneside, (5) some rural counties of the Eastern Midlands.

The second of the large maps suggests a belt of high rates on the south coast, but apart from this, all show extreme variations apparently entirely unrelated to environment, circumstances, efficiency of school medical or dental services, or to any recognizable factor. Areas with the highest and the lowest rates are sometimes next-door neighbours. These rates are approximately accurate ; they rest on the real fact of operation, not on diagnosis or assessment. Where they err, they err on the small side, as some operations performed outside the School Medical Service may not be recorded.

These rates cannot therefore be open to the criticisms justly directed to certain statistics of the School Medical Service. Judged by a comparison of these rates for 1936, a child living in Rutlandshire or the Soke of Peterborough is nineteen times more likely to undergo tonsillectomy than one living in Cambridgeshire. An Enfield child is twenty times more likely to have the operation than one in Hornsey. A child living in Bexhill would seem to enjoy climatic and cultural advantages at least equal to those of a Birkenhead child, yet he is twenty-seven times more likely to be submitted to operation.

Let us leave annual rates for a moment and find by actual numbers of operations performed during a nine-year period (the period of a child's elementary school life) what these local variations really mean.

Let us take the nine years 1928-1936. For our first illustration we will take two rural counties A and B, not far apart and not unlike save in size.

During these nine years A, with an average attendance each year of about 2,207 elementary school children, during the nine years had 1,010 children operated upon. If B, with an average attendance of 8,621 children, had had operations in the same proportion as A, we should "expect" that 3,945 children in B would have been tonsillectomized during this period. But the actual number was 335. Environment and circumstance were not very different, so that it seems 3,610 children, who would have been operated upon had they lived in A, were not operated upon because they

lived in B. There is no evidence that more children under school age were operated on in B than in A, or that the children in B are different from those in A in race, or in nutrition, hearing, physical, or mental development. Nor is there any evidence that they have suffered more from running ears, enlarged glands, or rheumatism. The School Medical Service of B is efficient and centred in its county town, a great seat of medical science.

For a second illustration, C and D are "dormitory suburbs" on the north of London and immediate neighbours. During the nine years in question C had an average attendance of 8,450 and D 6,584. D is perhaps, on the whole, slightly more prosperous and better housed. During the nine years 4,055 of C's elementary school children were tonsillectomized. If D had had operations at the same rate as C, 3,160 D children would have been tonsillectomized. But the actual number was 290. D has an experienced aural specialist and again there is no evidence that the education or development of the D population has suffered and some 2,870 children living in D have escaped operation, who, it seems fair to assume, would have undergone it had they lived in C.

REDUCTION OF INCIDENCE SUBSEQUENT TO 1931

Since 1931 most areas have shown a reduction, in some cases—for example, London and Wiltshire—substantial but gradual, but in others great and sudden. Of the latter type of reduction the first example was Hornsey Borough, where the reduction preceded the general movement by two years. Here Dr. Garrow in 1929, his first year as school medical officer, reduced the number of operations from 186 (2.9% of all children in average attendance) in 1928 (the average number for the seven years 1922–1928 being 169 (2.6%)) to 12 in 1929 and to an average for the eight years 1929–1936 of 13 (0.2%).

Judging by the returns for otitis media (which are now very low) and other conditions, nothing harmful, but rather the reverse, has happened from the substitution, in all but a most carefully selected fraction of cases, of conservative methods for operation, a substitution which has now been carried on for eight years. Diagram I

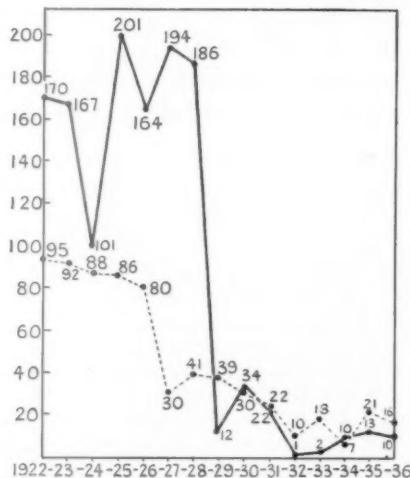


DIAGRAM I.—Hornsey Borough, 1922–1936. To show the great reduction in the number of tonsil operations. The cases of otitis media show no tendency to increase. Continuous line = Numbers of tonsil operations each year. Interrupted line = Numbers of cases of otitis media found at routine and special inspections.

illustrates the yearly numbers of tonsil operations and cases of otitis media discovered at routine and special examinations. On a larger scale was the courageous reduction in Derbyshire initiated in 1932 by Dr. Ash. In this county area the operations in 1931 were 2,626, or 3·9% of all the 68,079 children in average attendance. In 1929 the number had been 2,240, and in 1930, 2,316.

Dr. Ash reduced the numbers to 1,187 in 1932; 523 in 1933; 156 in 1934; 178 in 1935; 193 in 1936; 164 in 1937. If the 1931 rate had been maintained, some 15,700 further children would have been tonsillectomized since the reduction began. The actual number operated upon is 2,401; 1,710 in the first two years. Thus it seems that since 1931 some 13,000 children in Derbyshire have been spared the operation. Here again there seems no evidence that any harm has been done, or any advantage lost.

This is of course no easy matter to decide, as it is impossible to assess such things as the frequency of sore throats and colds in a County area, but attendance has not suffered and compares well with the average. Some light, however, may be thrown on the prevalence of some of the other conditions for which tonsillectomy is performed—such as otitis media and enlarged cervical glands—by the numbers of cases found at routine and special inspections in the schools. Table V and Diagram II show that this

TABLE V.—DERBYSHIRE (Dr. W. M. ASH).

Year	TONSILS AND ADENOIDS						OTHER CONDITIONS					
	Children referred for treatment			Children referred for observation			Children operated upon			Defective hearing, media.	Otitis media.	Enlarged cervical glands.
	Routine	Special	Total	Routine	Special	Total	Number	Per cent. of average attendance	Total cases*	Total cases*	Total cases*	Attendance† Per cent. No. on Roll
1929	3,383	975	4,308	1,503	81	1,584	2,240	3·3	192	258	843	89·7
1930	3,597	739	4,336	1,784	78	1,862	2,316	3·4	246	228	959	90·7
1931	2,030	816	2,876	2,334	471	2,805	2,626	3·9	219	243	815	90·3
1932	398	180	578	2,629	843	3,472	1,187	1·7	230	266	851	91·1
1933	283	473	756	2,896	813	3,699	523	0·8	222	258	976	90·3
1934	189	119	308	1,425	202	1,627	156	0·2	203	277	617	92·0
1935	234	78	312	1,178	194	1,372	178	0·3	164	225	622	91·1
1936	238	66	304	1,285	177	1,462	193	0·3	137	150	632	90·5
1937	218	68	286	1,211	156	1,367	164	0·27	171	201	643	89·5

* i.e. including all cases seen at either routine or special examinations and whether referred for treatment or for observation.

† The average percentage attendance in English County Areas was 1935–6, 89·7; 1936–7, 88·7.

great diminution in tonsillectomy has, so far at any rate, not been accompanied by any increase in the numbers of the cases of deafness, otitis media, or enlarged non-tuberculous cervical glands. In considering the figures for enlarged cervical glands the great prevalence of scarlet fever in the years 1933 and 1934 will be remembered. Parenthetically, I should like here to say that the increased attention now being given to hearing defect consequent upon the introduction of audiometer testing (attention which will soon be further stimulated by the publication of a Report now in the press) is almost certain to render future returns as to defects of hearing much higher than of old. This in future may appear to show an increase in defects of hearing, the exact opposite of the truth; what will have increased is the accuracy of ascertainment, due partly to the audiometer testing each ear entirely separately.

Another example of great reduction is Norfolk. Operations in 1931 numbered 1,729 or 4·4%; they were halved in 1932, and appear to be stabilized at less than one-third, being 1·1% in 1936 and 1·5% in 1937.

No unsatisfactory reports have been received of the results of conservative treatment in any area. Dr. Bullough [3] (Essex) for example says: "No unsatisfactory

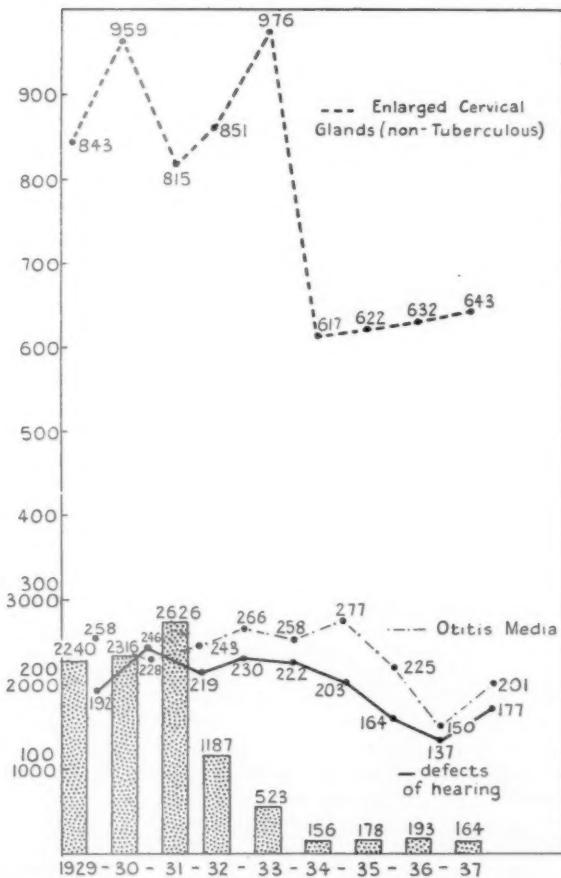


DIAGRAM II. Derbyshire.—To show that the great reduction in tonsillectomy in Derbyshire has not resulted in any increase in the numbers of cases (found at routine and special medical inspections) of defective hearing, otitis media, and enlarged (non-tuberculous) cervical glands. The columns representing numbers of tonsillectomies each year are on a scale of height one-tenth of the curves of the other conditions. Percentage attendance is not shown, but is unaffected and is well above the average of English counties.

result has been seen from conservative treatment in a large number of cases, where the tonsils showed definite enlargement."

THE SOCIAL INCIDENCE OF TONSILLECTOMY

The social incidence of tonsillectomy is the most puzzling feature of its aetiology.

Although tonsillitis seems common to all classes of society, the incidence of tonsillectomy is at least threefold heavier in the children of the well-to-do. The annual operation rate on elementary school children in England and Wales in 1936 was 1·7%. The average for the last nine years would be somewhat higher, and multiplying this by nine for the nine years of elementary school life and making some allowance for operations performed in the pre-school years, we may estimate that at the present time some 20% of elementary school children have been tonsillectomized before the age of 14. For the last seven years, of new boys just about the same age of 14 years, at one of our most famous public schools, the senior medical officer of the school tells me, 75% have been tonsillectomized before entry, and that his latest figures are 83%. This school is not one of those 17 public schools mentioned later.

In 1928 Paton [25] found in a large public boarding school for girls at St. Andrews, 42% of 424 girls were tonsillectomized before the age of 14 years.

The recently published Report [22] of the Schools Epidemics Committee of the Medical Research Council gives the following information relating to seventeen large public boarding schools for boys, and nine large public boarding schools for girls.

When the inquiry began in 1930, 52·5% of boys and 43·3% of girls had had their tonsils removed. In every subsequent census these proportions of tonsillectomized pupils increased, until in 1934 we find that the figure for the boys was 58·2%, and that for the girls was 50·1%, a rise of nearly 6·0 and nearly 7·0% respectively.

For the last two years of the inquiry a record was kept each term of the number of new entrants who had previously undergone tonsillectomy, and during this period an average of 59·2% of boys (boarding) and 45·3% of girls (boarding) were tonsillectomized before entry.

Between January 1930 and July 1934 16 of the 17 boys' boarding schools showed increases in the proportion of tonsillectomized pupils varying from 1·3% to 15·2%. Only one boys' school showed a reduction of 1·7%. Seven out of the nine girls' boarding schools showed increases varying from 2% to 12·2%. Two girls' schools showed decreases, one of 0·3%, the other of 2·8%.

At the end of the inquiry, the boys' school showing the highest proportion of tonsillectomized had 70·5% of all boys in the school tonsillectomized; the school³ with the lowest proportion had 50·7%. Of the girls' schools the highest proportion was 63·6%, and the lowest 42·4%.

Incidence by physical type.—As regards boys' schools, Dr. Wilson and I found, in 1932, that, of the first fifteen and first elevens of eighteen public schools, 141 or 54·4% of these picked athletes were tonsillectomized. All boys of these schools at this time had a proportion of 54·7%.

INCIDENCE OF MORTALITY FROM TONSILLECTOMY IN CHILDREN UNDER 15 YEARS

Diseases of the tonsil.—Before coming to deaths directly assigned to tonsillectomy it may be well to remind you that deaths assigned to diseases of the tonsils have notably increased both in children under 15 and in adults. The Registrar-General's Statistical Review for 1935 states (p. 115) that :

³ Two schools (U/B and V/B) shown in the Report with lower percentages are not public boarding schools.

"At ages under 5 the increase in mortality between 1921-5 and 1931-5 amounted to 72% for boys and 76% for girls; at 5-10 the rates of increase were 74 and 78% respectively, and 10-15 80 and 82%. At ages 15 and upwards the male death-rate increased in the same period from 8 to 21 per million or by 162%, and the female rate increased from 7 to 26 per million, or by 271%".

The review proceeds to point out the parallelism between recent movements of the rate and those of death-rates from septic diseases.

Tonsillectomy.—In 1932 Layton pointed out that the mortality directly due to tonsillectomy was greater than is usually appreciated. The Registrar-General's Statistical Review for 1935 includes a review of this mortality for the years 1931-1935. Enlarged tonsils or adenoids were given as the cause of 60 deaths, and tonsillectomy—without specification of the disease for which the operation was performed—was given as the cause of 513 deaths, 369 being deaths of children under 15. These numbers do not represent all the deaths following tonsillectomy in the five years, since deaths with mention of tonsillectomy in conjunction with the disease of the tonsils necessitating the operation are classified in tabulation to the particular disease mentioned and a considerable number of deaths following operations are therefore included under other headings in the table, such as enlarged tonsils. The number of deaths classed to diseases of the tonsils which occurred under or associated with anaesthesia are separately shown in Table C IV, p. 157, and corresponding tables for previous years, and the total of such deaths during 1931-1935 was 231, 140 of males and 91 of females. Dr. Stocks tells me that 85 of these 140 deaths of males and 56 of the 91 deaths of females (141 in all) were of children under 15.

From the following table it appears that at least 85 deaths of children under 15 occur on an average each year from tonsillectomy, and that, in all probability, this is a very conservative estimate.

TABLE VI*.—DEATHS FROM TONSILLECTOMY IN CHILDREN UNDER 15. 5-YEAR PERIOD 1931-5.

		Boys	Girls	Both sexes
Tonsillectomy (unqualified)	...	210	159	369
Adenoids ...	...	12	8	20
Enlarged tonsils ...	...	20	15	35
5-year period	...	242	182	424
Annual average	...	48.4	36.4	84.8

[Included in the above groups (or in other diseases of tonsils) are the deaths of 85 boys and 56 girls under 15 in which death occurred under or associated with anaesthesia.]

* From the Registrar-General's Statistical Review for 1935, p. 115, and information kindly supplied by Dr. P. Stocks.

In conclusion: I have endeavoured simply to present the incidence of tonsillectomy, and to avoid entering those other tempting paths of investigation, which others besides myself have pursued on previous occasions and in other places, such as the accepted indications for which tonsillectomy is performed, its risks, and the end-results achieved. I have also avoided any reference to the highly important question of sinusitis. A few comments have crept in, but in the main I have left the strange facts of incidence to speak for themselves.

SUMMARY

(1) The incidence of operations upon the tonsil remained low until after the beginning of the twentieth century. About 1902-1903 a rapid rise began, there was a partial lull during the War years, after which the rise accelerated sharply, reaching a peak in 1931. There was then a sharp fall. In 1936 a second rising curve began.

(2) The incidence is higher in boys than in girls.

(3) The highest age incidence is in the period 5-7 years, the peak being usually in the 6th year. The age distribution is somewhat older in girls than in boys.

(4) More attention should be given to sex—and, especially, to age-grouping in considering the necessity for operation, and in assessing its results.

The recent work of Epstein [10] and others suggests that the present age distribution is too young for the best results to be obtained.

(5) The high incidence between 5-7 years is due to many operations being performed on tonsils for enlargements which are either (a) physiological—associated with the great changes in development and in the oral cavity which takes place at this critical period; or (b) immunological—in response to the unaccustomed herd infections of the new environment of school, or to the sepsis sometimes resulting from the decay of the primary dentition.

(6) A study of the geographical distribution in elementary school children discloses no correlation between the rate of incidence and any impersonal factor, such as over-crowding, poverty, bad housing, or climate. Incidence is not correlated with the general efficiency of the school medical and dental services of the area. In fact it defies any explanation, save that of variations of medical opinion on the indications for operation.

(7) Large and, in some cases, drastic reductions in the numbers of operations performed in elementary school children in certain areas have had no unsatisfactory results.

(8) Puzzling as is the geographical distribution, the social distribution is yet more of an enigma. Tonsillectomy is at least three times as common in the well-to-do classes. The more fortunate the child in all other circumstances, and the better the opportunities for careful nurture, so much the more is he liable to tonsillectomy.

(9) In the public schools the picked athletes among the boys are tonsillectomized in exactly the same proportion as the other boys in the schools they represent.

(10) The mortality from the operation is larger than is generally appreciated.

(11) Though, as Dean [7] has recently said, "Practically the removal of tonsils is always a gamble" yet no impartial observer will deny that, in certain cases, tonsillectomy has brilliant results. "In a properly selected case there is no single operation in children's medicine more successful or that shows such dramatic results as that of tonsillectomy" (Paterson [24]). The facts enumerated above with regard to its incidence suggest that the conspicuous success of the operation in such cases has led to its adoption in many doubtful cases, and that it is too often performed without adequate cause, or sufficient regard to the possibility of enlargement being temporary, physiological, or immunological. With Paton [25] they seem to question "the justification for so widespread an attack upon a normal structure of the body", and to suggest that the probability that the tonsil serves some useful purpose, its tendency to spontaneous involution, and the success of non-operative methods of treatment are often alike overlooked in a too-hasty resort to "symptomatic treatment in its most elementary form" (W. H. Bradley [2]).

(12) The strange bare facts of incidence seem to support the opinion expressed on other grounds by the Schools Epidemic Committee [22] of the Medical Research Council that "it is a little difficult to believe that among the mass of tonsillectomies performed to-day all subjects for operation are selected with true discrimination, and one cannot avoid the conclusion that there is a tendency for the operation to be performed as a routine prophylactic ritual for no particular reason and with no particular result".

REFERENCES

- 1 ASH, W. M., Reports to the Derbyshire Education Committee 1931-7.
- 2 BRADLEY, W. H., *Arch. Dis. Childhood*, 1930, **20**, 359.
- 3 BULLOUGH, W. A., Report to the Essex Education Committee, 1936, 11.
- 4 CLOSE, H. G., *Guy's Hosp. Rep.*, 1930, 45.
- 5 COLLINS, S. D., and SYDENSTRICKER, E., *Pub. Health Bull.*, 1928, No. 175.
- 6 CUNNINGHAM, RUBY L., *Arch. Int. Med.*, 1931, **47**, 513.
- 7 DEAN, L. W., *J. A. M. A.*, 1934, **103**, 1044.
- 8 DEAN, E. M., Report of the School Medical Officer, Newcastle, 1930.
- 8A DIGBY, KENELM H., "Immunity in Health", 1919, Oxford Univ. Press, p. 93.
- 9 ELLIS, R. W. B., and RUSSELL, A. E., *Lancet*, 1937 (i), 1304.
- 10 EPSTEIN, I. M., *Am. J. Dis. Child.*, 1937, **53**, 1503.
- 11 FAULDEE, T. J., *Lancet*, 1910 (ii), 21, and 97.
- 12 GARROW, R. P., Rep. Sch. Med. Officer, Borough of Hornsey.
- 13 GLOVER, J. A., and WILSON, J., *Brit. M. J.*, 1932 (ii), 806.
- 14 GOODHART, J. F., "Diseases of Children". Churchill, 1885.
- 15 GRIFFITH, L., *Lancet*, 1937 (ii), 723.
- 16 HARRIS, H. A., "The Primary School". London, 1931, p. 225.
- 17 "Health of the School Child." Annual Reports of the Chief Medical Officer of the Board of Education for the Years 1923, p. 28, and 1931, p. 55.
- 18 HEWITT, E. S., and GEDDIE, K. B., *Am. J. Hyg.*, 1932, **15**, 1.
- 19 JAMES, W., WARWICK, and HASTINGS, S., *Proc. Roy. Soc. Med.*, 1932, **25**, 1343 (Sect. Odont., 39).
- 20 LAYTON, T. B., "Conservation of the Lymphoid Tissue of the Upper Respiratory Tract". London, 1931; *Lancet*, 1934 (i), 117.
- 21 London, Report of the School Medical Officer for 1931, 5.
- 22 Medical Research Council, Report No. 227, "Epidemics in Schools", 118.
- 23 NEUBER, E., "Hygienic Condition of Debrecen School Children". Budapest, 1932.
- 24 PATERSON, D., and BRAY, G. W., *Lancet*, 1928 (ii), 1074.
- 25 PATON, J. H. P., *Quart. J. Med.*, 1928, **88**, 109.
- 26 Report of the Chief Medical Officer, Ministry of Health for 1931, p. 249.
- 27 TILLEY, H., *Post-Grad. M. J.*, 1934, **10**, 6.

Discussion.—The PRESIDENT said that the views expressed by Dr. Glover were consonant with the policy of the Board of Education which had repeatedly discouraged indiscriminate tonsillectomy. He himself had for many years held that the tonsils performed a useful function in the body and were a barrier to throat infections.

Unfortunately, it was still the honest belief of many practitioners that a large proportion of children should have their tonsils removed; this belief had spread to the laity and the influence of parental pressure could not be ignored.

It was sad to reflect that many of the anaesthetic deaths mentioned by Dr. Glover were due to the children's having undergone an unnecessary operation.

Mr. T. B. LAYTON said that his experience did not go back to 1903, the time at which Dr. Glover had found the first rise in numbers of these operations. In 1911, however, he had already begun to teach that too many were being done, for he remembered as a junior submitting to his Chief, Mr. F. J. Steward, whom he succeeded in the Throat Department at Guy's Hospital in 1912, the first draft of his paper, read before the Medical Society of London in March 1914.⁴ Later he was away for four and a half years, and on his return to civil practice he found that the numbers of operations had increased to an enormous extent. He tried, he hoped impartially, to reconsider the whole subject to see whether his former views were wrong. He came to the conclusion that they were not, and found himself becoming more—not less—conservative. In the subsequent years this had continued, and he found himself advising tonsillectomy in children less and less.

He thought that the indication he had learnt from Hajek was the sound one. It was that if within one year there were three attacks—or two with joint pains—of acute inflammation of the tonsils which one felt confident were due to organisms living within them and not to any that were picked up from without, these organs should be removed. When one had this indication one was on sound ground. Whenever it was absent there was a possibility that one would not get the results from operation for which one hoped. He was quite willing to admit that there were many cases in which the operation had to be considered without this indication being present, but in all such cases he found it very difficult to decide.

⁴ *Trans. Med. Soc. Lond.*, 1915, **37**, 244.

He believed that that was one of the reasons for so many operations being done. People thought it was an easy decision to make, whereas it was a very hard one, involving the weighing of pros and cons affecting not only the throat and the whole body, but also the conditions of life and the hygiene of the home. He thought that in every case at least as much time should be given to deciding whether any operation should be done, as to the doing of it. He had found that very often in making his decision it was certain contraindications upon which he relied. Thus he did not believe it was right to operate upon children under the school age and would not do so unless the three attacks were definitely proven, which was very seldom at this time of life. But while he laid down 5 years as the definite rule, he found his mind subconsciously putting up the age as time went by; and he was now very loath to operate under the age of 10. In this connexion it had to be remembered that when the operation upon tonsils had first been advocated, the children upon whom it had been performed were the older ones at the period of the school-leaving age and not the young ones upon whom the operation was so often performed to-day. Then there was the question of the period of the year. In the days when many operations had been done in the out-patient department and the children had been sent home, Mr. Steward used to shut down all such operations during the winter. He (Mr. Layton) remembered him saying what an advantage that was, because one learned, by waiting, how many cases, especially of adenoids, were found not to need any operation at all. The logical evolution of this line of thought was that one should do no operations upon tonsils and adenoids in the winter months at all, and that was the rule that he now followed. When the L.C.C. had made arrangements so that no children were sent home for forty-eight hours after the operation he had felt that the Council was right and he had ceased to do tonsil and adenoid operations in the out-patient department at any time of the year. But while he had learned these principles from his seniors and employers there was one point that he had learned from his own experience as ear surgeon to the Fever Service of London. That was the devastating effect upon the ear that might result supposing measles developed in a child within a week of the tonsils being removed. So severe and so dangerous to life had been the conditions of mastoiditis that arose under these conditions that to-day he would not take out a child's tonsils during a measles epidemic unless the patient had already had that disease.

Turning to certain symptoms and diseases which had to be considered in the problem : He had learned in the throat clinic in Berlin to take the temperature just before the time for operation and to defer the operation if that was above 99° F. He did not believe that recurring colds were ever cured by tonsillectomy. It was true that after the operation certain children ceased to suffer from colds, but many children suddenly grew out of the habit of catching colds before operations on the tonsils were devised, and many parents were bitterly disappointed because, though they had been persuaded that the operation would stop their children catching colds, the colds had continued as before. He admitted that the question of acute rheumatism was a debatable one. There was one form of rheumatism, however, in which tonsillectomy might not only be valueless but definitely harmful, and that was chorea. When it was necessary to operate upon a choreic child, he first asked the physician to be sure that the disease was quiescent, and after the operation kept the child in bed behind screens until the faecal wounds were healed at the end of a fortnight. Even thus one was not quite safe, for two of the worst cases of chorea that he had ever seen had supervened upon tonsillectomy in children who previously had never been suspected of chorea or of any other form of acute rheumatic disease.

Finally he turned to the problem of hygiene. He did not suppose, except for one possibility, that the removal of the tonsils in the well-to-do, living under good hygienic conditions, did much harm ; but he was convinced that in the children of the poor, living under conditions of bad hygiene, removal of the tonsils might be a very serious matter. He had known children after the operation go straight down hill and die without any obvious reason. They seemed merely to fade away. It was necessary to remember that those attending out-patient clinics to-day were not all poor. There were as many, and perhaps more, of those people living in little houses who, though they had to consider every penny of the weekly budget, were not poor. Their children were brought up under conditions of hygiene, as good, and perhaps better, than those of the most wealthy in the land. The difference with regard to tonsillectomy was not between those who paid for their children's education and those who took advantage of that provided by the State but between those whose

weekly income was sufficient to guarantee, under good management, a good standard² of hygiene, and those whose uncertain daily takings could never guarantee this, however wonderful were the mothers—as so many of them were.

In his opinion no child living under conditions of overcrowding should ever have the tonsils removed if it could possibly be avoided. In those cases where he found it essential, usually under pressure from a colleague in another department, he arranged with the almoner for the child to be sent to a convalescent home for at least a month and then to be transferred direct to the ward where he kept it, as in the cases of chorea, for a full fortnight, after which it returned to the convalescent home for another month.

Mr. E. D. D. DAVIS said that the tonsil had a definite function, it was a specialized lymphatic gland, it had the structure of a lymphatic gland, and behaved like one. Owing to its exposed position it was specially susceptible to attacks of inflammation.

The classification of tonsillitis should be: (1) Primary; (2) Secondary.

Primary tonsillitis arose from infection from one patient to another, from infected milk, water or food, and it could be part of a general infection such as scarlet fever and measles.

Secondary tonsillitis arose from a septic focus such as septic teeth or nasal suppuration. Tonsillitis was sometimes secondary to sepsis following the extraction of teeth or a nasal operation.

When the tonsil was enucleated, its function was taken on by other lymphatic glands. Acute cervical adenitis was common and more severe in tonsillectomized patients. The function of the tonsil did not appear to receive sufficient consideration in the selection of cases for operation.

He agreed with Mr. Layton that measles arising soon after tonsillectomy and during convalescence after this operation was more severe and might lead to a dangerous otitis media and mastoiditis, but he did not think that measles and scarlet fever were more severe in a tonsillectomized patient who had completely recovered from the operation.

Dr. Glover had referred to the high incidence of tonsillectomy in new boys arriving at Public Schools in 1937. These boys would be about 6 years old in 1930-31, a period when the tonsillectomy incidence was very high, and further, 6 years was the age at which most tonsillectomies were performed.

More careful selection of cases for operation was needed. There was a great personal equation in such selection. The tonsil operation was performed by any and every surgeon, but he (Mr. Davis) firmly believed that the ear, nose, and throat, specialist was very careful in the selection of cases, taking at least twenty minutes in examining the patient, seeing the doubtful case again, and honestly trying to avoid unnecessary operation.

Dr. PERCY STOCKS said that Dr. Glover had presented a strong case. It appeared from the statistics that, at present rates, out of every 100 children born into all classes of England and Wales some 25 or 30 would be tonsillectomized before the age of 14. For comparison with this estimate the United States Public Health Report of April 22, 1938, contained an instructive record of all operation rates amongst 39,185 individuals taken from 18 States and all social classes, ascertained by family visitation over a period of four years 1928-31. From this sample it appeared that out of 100 children born 54% would have been tonsillectomized by their 14th birthday, assuming the rates during 1928-31 to be maintained. He (Dr. Stocks) confessed that Dr. Glover's paper made him feel rather despondent about some aspects of so-called "progress" and he thought that such a paper was long overdue. Twenty years ago about 50,000 tonsillectomies were being performed annually on elementary school children. Had a statistician at that time asked that a large control experiment should be arranged by giving and withholding the operation for alternate children and recording their subsequent school medical histories he would have been met by the usual answer: "If we believe that this treatment is beneficial, then it is unfair to withhold it from one half whilst giving it to the other half." He thought that the reply to such an objection was that in the absence of proof that a treatment is beneficial there is also no proof that it is not harmful, and there were signs of an awakening consciousness to that fact amongst the medical profession to-day. It took a long time to establish or disprove the efficacy of any new form of treatment, even by prearranged statistical studies, but thirty years was too long to remain

in doubt as to the value of a surgical treatment to which a quarter of the population was being subjected. It would not now always be easy for the school medical officer to persuade parents that the tonsils should be left alone. Nevertheless, that which courageous pioneers in Derbyshire and elsewhere had succeeded in doing, without the backing of such evidence as that which Dr. Glover and others had assembled, could and should now be done in all those parts of the country where the statistics showed that tonsillectomy was being practised in excess of the essential minimum.

Dr. R. P. GARROW said that some of the strange facts presented by Dr. Glover in regard to the incidence of tonsillectomy might be explained by a psychological factor of great importance—namely, maternal anxiety. Maternal anxiety varied with social circumstances, being greater amongst the better-off mothers who had fewer children. It was also, in his experience, greater in regard to boys than girls. This factor alone was sufficient to explain the higher incidence of unnecessary operations (of which tonsillectomy was the commonest) in boys than in girls and in the well-to-do as compared with the poorer classes.

JOINT DISCUSSION No. 5

Sections of Surgery, Medicine, and Anæsthetics

Chairman—G. GREY TURNER, M.S. (President of the Section of Surgery)

[March 2, 1938]

**DISCUSSION ON MASSIVE COLLAPSE OF THE LUNG
AS A COMPLICATION OF SURGICAL OPERATIONS**

Dr. C. Price Thomas: Atelectasis has been recognized as a definite entity for close on a hundred years. Gairdner, in a series of papers between 1850 and 1854, gave a clear description of the condition, differentiating it microscopically from pneumonia and postulating that it was caused by retained secretions. It was not, however, until about twenty-five years ago, when Pasteur published his series of articles (1908-10-11), that interest was further stimulated. Pasteur confirmed the pathological findings of Gairdner, but suggested that the cause was diaphragmatic paralysis, explaining the retained secretions as being squeezed out of the lobe during collapse. Elliott and Dingley (1914) again drew attention to the part played by obstruction to the bronchus, and this observation has been confirmed both clinically and experimentally by many observers. It can be quite definitely accepted that bronchial occlusion constitutes a cause of atelectasis, but whether it is the only cause is perhaps a moot point, and it behoves us to go warily before accepting this as a final statement of the whole truth, since atelectasis is important not only in itself, but also as a precursor of more grave pathological conditions, such as bronchiectasis, and perhaps as an underlying factor in many problems in pulmonary pathology which at present we do not understand.

Although bronchial occlusion admittedly explains nine-tenths or more of the cases, there are some which are difficult of acceptance on these grounds. W. D. W. Brooks has recently advocated the production of an artificial atelectasis as a means of producing selective collapse in certain cases of pulmonary tuberculosis. Collapse is brought about by the introduction of a fine catheter, bearing an inflatable balloon, into the selected bronchus through a bronchoscope. The balloon is inflated in order to produce occlusion, and the lobe is then aspirated of as much air as possible, up to a negative pressure of about -31 mm. of mercury. It is found that collapse takes from four to six hours to achieve in these circumstances. This gives us some idea of the length of time necessary, after the onset of the occlusion, for the production of the collapse, and this evidence confirms the view that those occasional cases in which collapse occurs suddenly cannot be the result of occlusion, since there does not appear to be sufficient time for the absorption of the contained air. Mr. J. E. H. Roberts has reported a case in which collapse suddenly occurred, under observation, with the chest open, at the moment when intratracheal aspiration was started. Kerley also observed collapse occurring suddenly in a young child while a bronchography was being carried out with an intratracheal catheter.

It seems to me that this type of case cannot be explained on the grounds of

occlusion, since the collapse occurs as suddenly as the inciting cause. If the observations of Brooks with regard to artificial occlusion can be taken as a guide as to the happenings in pathological cases, some hours must elapse before its achievement, and it seems that some explanation on a neuromuscular basis will have to be adduced to account for this group. Rose Bradford's suggestion that in his case, the condition—following a contralateral chest injury—was due to a nervous mechanism, may have more to be said for it than is generally believed at present.

B. H. Williams observed that mechanical stimulation of the visceral pleura in dogs caused shrinkage of the lung. This has not been confirmed, but it serves to draw attention to a considerable gap in our present knowledge of the neuromuscular mechanism of the lung.

Brauer, in a personal communication, pointed out the variations in size of any individual bronchus at different times as shown by bronchography, and as a result of this observation suggested that certain segments, during quiet respiration, became quiescent, no bronchial air exchange taking place in them during their periods of rest. This is a reasonable assumption, and falls into line with our ideas of segmental quiescence in other organs. It may have some bearing on the production of lobular collapse.

Waters, of Madison, Wisconsin, while investigating diffusibility rates of gases in the lungs of dogs, occluded the bronchus of one lung with a balloon catheter; hyperventilation was then induced with carbon dioxide, the dog being allowed to breathe oxygen through the catheter during the period of hyperventilation, the catheter being then occluded. He found that invariably a collapse occurred in from fifteen to thirty minutes, also, incidentally, that the lung could not be inflated even with high gas pressures except after severe manipulation of the lobe. Collapse also occurred when carbon dioxide or nitrous oxide was substituted for oxygen. A combination of this observation with that of Brauer's may provide an explanation of the lobular type of atelectasis, when a carbon-dioxide-oxygen mixture has been used to wash out the anaesthetic, since during the period of lobular quiescence, absorption may take place more rapidly than diffusion in a segment which is taking no part in the respiratory exchange. Waters makes an interesting observation in this connexion, namely that after abandoning the use of a carbon-dioxide and oxygen mixture for washing out the anaesthetic and substituting carbon-dioxide air, it was found that the incidence of post-operative pulmonary complications showed a marked diminution.

As already stated, probably nine-tenths or more of the cases of collapse following surgical operations are a result of bronchial occlusion. If we accept that as a fact, then a review of the incidence of the condition and an attempt to explain the occurrence of the two underlying factors should give us at least a working idea of the mode of occurrence of this admittedly important post-operative complication. These two factors are the presence of a secretion and the patient's inability to expel it. The presence of a secretion needs no hypothesis, although in a normal healthy bronchial tree the amount is merely sufficient to keep the mucosa moist. Secretion is present in excess only as a result of irritation by infection (the commonest agent), foreign material, the action of drugs, or, possibly, as a result of nervous stimulation.

The secretion in these cases is characteristically thick and tenacious, a fact which makes its dislodgment difficult. The bronchial glands are sero-mucous in character and not purely mucous, and in catarrhal infections of this type, as in salivary glands, the serous secretion is inhibited to a greater degree than the mucous one.

Drugs doubtless play a part in aiding the production of this secretion. Some surgeons deplore the use of atropine on this score, although it is doubtful whether its use as a pre-operative measure is objectionable when ether is the anaesthetic to be used, since under these conditions its action is not unopposed. Hyoscine, however, has not come under this ban, yet its use is very prevalent and its action in drying-up

oral secretions—and probably also bronchial secretions—is nearly equal to that of atropine. This drug, too, is used in conjunction with local and spinal anaesthesia, and may be a contributory cause in these cases.

Irritation—using the term loosely—may be induced by the inhalation of secretions from the upper air passages, stomach contents, or by foreign bodies such as blood-clot, tartar from teeth, &c.

The factor of deficient power of expulsion is bound up with those post-operative factors which tend to limit the patient's desire and ability to cough, and also his ability to take in sufficient air to produce a good expulsive effort. The two main factors are pain and lack of muscular power.

A correct appreciation of the factors attending operations which favour the occurrence of the above events will not only tend to decrease the incidence of post-operative complications, but will be of assistance in directing treatment.

It is more or less generally accepted that the type of anaesthesia used plays no great part in the production of this condition. King (1931), in his review of cases operated on in the Massachusetts General Hospital, showed that the incidence after inhalation anaesthesia was 12.4%, after ether and spinal anaesthesia 18.3%, after spinal anaesthesia alone 16.7%, and after local anaesthesia 18.4%. These figures are close enough to suggest that the type of anaesthesia has, *per se*, no influence on the occurrence of the lung condition. It is, however, interesting to note that the combination of spinal anaesthesia with ether anaesthesia shows a higher rate than either alone. Other figures published, such as those by Brown and Debenham (1932) show a preponderance with spinal anaesthesia over five times greater than with inhalation.

So many factors are present in producing this condition that care must be exercised in assessing any single one, and figures showing any great discrepancy in different types of anaesthesia must be accepted with due care. Preliminary narcotization of the patient, which in this country is practically a routine, in itself predisposes a patient to aspiration into the tracheobronchial tree. We know that lipiodol gently instilled into the nose during sleep can next morning be demonstrated in the bronchi. Local and spinal anaesthesia are in some clinics reserved in the main for those patients who are considered bad risks for general anaesthesia, either because of their poor general condition or because of the presence of a known respiratory ailment, e.g. bronchitis; in fact, those cases in which post-operative complications are most likely to occur. These two factors alone tend, if not to load the balance against local and possibly against spinal anaesthesia, most certainly to make the incidence of complications as common as after inhalation methods.

Type of operation has more bearing on incidence apparently than any other single factor. Everyone is agreed that operations on the abdomen are much more liable to complication than those on the extremities, and of abdominal operations those on the upper abdomen more than on the lower segment, with the exception, as King points out, of appendicectomy, with drainage, and appendix abscess, both of which show a high rate. King shows that males with upper abdominal conditions present a peculiarly bad risk, operations on stomach and duodenum in this group showing a 46.8% incidence.

The rigidity of the abdominal musculature following abdominal section is probably a great factor in the high incidence after this type of case. There are no figures to show that strong retraction during operation increases the patient's liability, but it must be generally recognized that it is certainly a great factor in post-operative pain, and its avoidance is advisable. Churchill (1927) pointed out the decrease in vital capacity after abdominal operations, which is a direct result of the rigidity of the abdominal musculature. Overholt (1930) also demonstrated the elevation of the diaphragm after abdominal exploration, an elevation which affects the right side more

than the left. He also noted a decrease in the diaphragmatic movements of about 66% of the pre-operative level. Carlson (1932), investigating respiratory movements after operations by means of what he calls pneumography, in which thoracic and abdominal respirations could be gauged graphically, found a marked decrease in the latter with increase in the former in this type of case. His readings of the thoracic excursion were taken from the upper zone. He notes that with spinal anaesthesia thoracic respiration does not preponderate until the anaesthesia has worn off and pain commences. Carlson draws attention to the predominance of collapse at the right base and quotes Lowenthal, who reports five cases of non-specific pneumonia complicating phrenic evulsion. This factor of deficient pulmonary ventilation due to restricted abdominal and diaphragmatic movement, results from the mechanical interference and resulting pain.

The mid-line and transverse incisions are again finding favour in view of the decreased post-operative pain, and personal experience in the use of the latter confirms the impression that cough produces less pain with this incision than with the paramedian.

Sepsis as a cause is shown by the high incidence in appendectomy with drainage, or in appendix abscess. It is doubtful whether the infection, *per se*, has any influence, or is merely a factor in post-operative rigidity and discomfort. These patients also demand urgent operation, so that the presence of a respiratory infection must be ignored and the added risk taken.

Subphrenic abscess should prove a prolific source of post-operative pulmonary complications, but it is remarkable how seldom the lung itself is affected post mortem in these cases, except as a terminal event.

Respiratory infection plays an important part in the aetiology, and although no one operates on a patient suffering from an acute respiratory infection except in case of emergency, we have all doubtless been guilty, consciously or unconsciously, of operating on patients with milder degrees of infection, pre-operative evidence of which has quite possibly escaped even the patient's observation.

King's bad-risk group of males with upper abdominal operations is possibly explained by factors which tend to be more common among males than among females. In the first place, this type of case is often a subject of bad oral hygiene. These patients are often smokers, and subject to smoker's cough. They are more commonly subject than women to adverse circumstances of work. Moreover, men as a rule are more dependent on diaphragmatic respiration than women, and interference with the abdominal musculature will constitute a greater handicap.

Once collapse has been established, a great deal will depend on the severity of the accompanying infection as to whether true inflammation of the parenchyma occurs or not, and the type of resulting inflammation (e.g. pneumonia or abscess) again depends on the type and virulence of the infecting organisms.

Clinically, the onset of post-operative collapse occurs within the first forty-eight hours, although rarely it may occur as late as a week after operation. The onset is usually rapid, and accompanied by a rise in pulse, temperature, and respiration. Pain is nearly always present, but in varying degree, occasionally being severe enough to suggest an embolism; this occurs in the type of case having an abrupt dramatic onset. Respiratory distress is a variable feature also, in some cases being practically absent, although it may be very real, and when present in severe degree may be accompanied by cyanosis. Cough is invariably present and nearly always productive; if not productive, it is a moist rattling cough, giving the impression of retained secretions which refuse to come up. The sputum when produced, is mucopurulent from the onset, and is never blood-stained. The presence of blood, altered or unaltered, demands a different diagnosis, and the absence of cough of the wet variety, with or without sputum, makes the diagnosis very doubtful.

Physical signs.—The classical picture of dullness on the affected side with evidence of cardiac displacement to that side may be present ; this displacement, however, will be absent when the collapse is bilateral, a not infrequent occurrence. Physical signs vary greatly in different cases and, in the same patient, in different places. Dullness is constant, absent breath-sounds, moist sounds, or bronchial breathing may be present, the latter due to conduction through airless tissues when the bronchus is clear.

X-rays.—X-rays are by far the most valuable aid in the diagnosis. There is a characteristic sharply defined triangular shadow in basal and apical cases ; middle-lobe involvements in the antero-posterior films do not show anything so characteristic, but the lateral film shows a typical wedge-shaped shadow which, however, may be confused with an interlobar effusion or an overlap of a high diaphragmatic shadow over the heart shadow.

When the collapse affects less than a lobe, the shadow is not so characteristic unless the film happens to get the segment in profile as it were. Patchy collapse radiologically, cannot be differentiated from bronchopneumonia, but when the radiological and clinical features are associated the diagnosis can be made with reasonable certainty.

Illustrative Case

Patient, a woman, aged 36. *Exophthalmic goitre operation*, January 21, 1937. Local anaesthesia (infiltration), 1 per cent. novocain. Pre-operative morphia, $\frac{1}{2}$ gr.

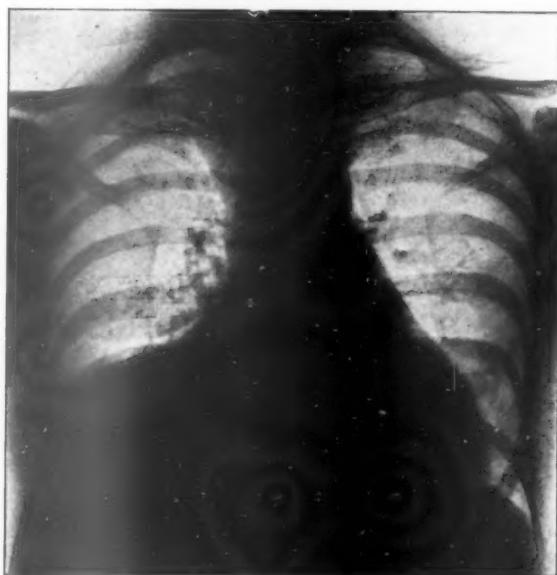


FIG. 1.—Post-operative collapse, right side, following thyroidectomy ; local anaesthesia.

hyoscine 1/100 gr., and paraldehyde 1 drachm per stone body-weight, per rectum. Post-operative hyperthyroidism twenty-four hours afterwards. Basal 'collapse' on right side noticed eight days after operation (fig. 1) followed by collapse of

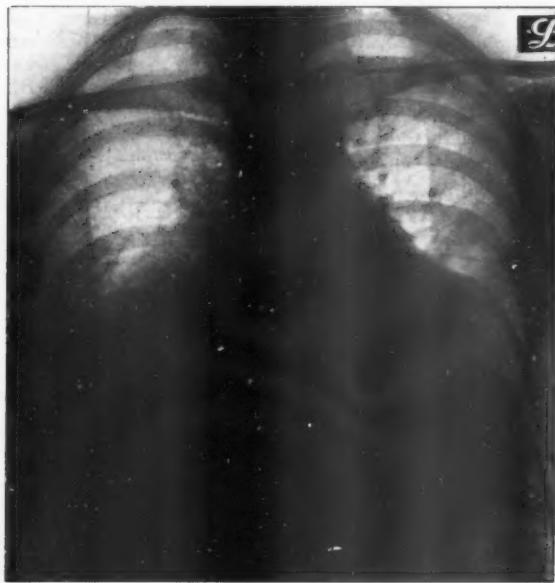


FIG. 2.—Same case, three days later; both lower lobes collapsed.

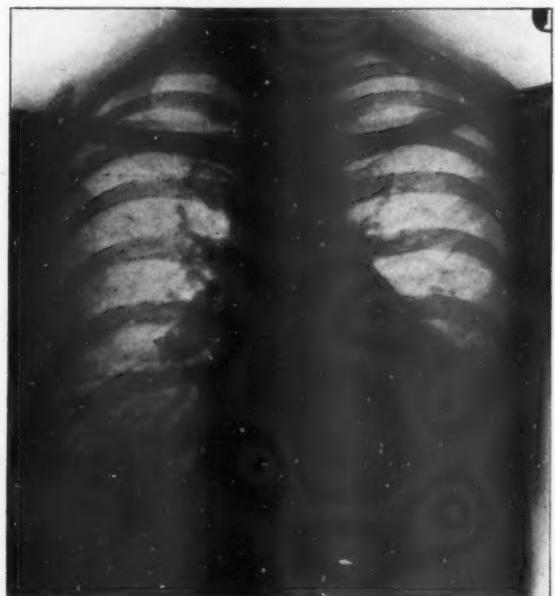


FIG. 3.—Same case; right side clear.

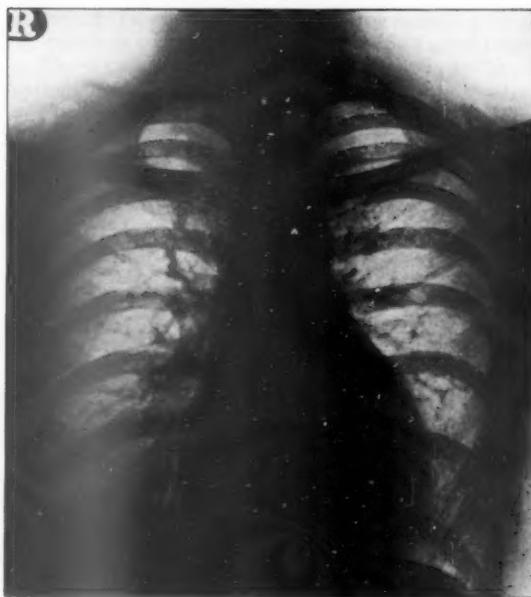


FIG. 4.—Same case; both lower lobes re-expanded.

opposite lower lobe a fortnight later (fig. 2). Recovery slow. Right side clear two months later (fig. 3); left side found to be expanded four months after onset (fig. 4).

Treatment.—Treatment, as in so many conditions, should be divided into prophylactic and therapeutic. Prophylaxis depends on recognition of the factors which tend to predispose to the condition. Recognition and elimination, if possible, of infections of the respiratory tract, both upper and lower, and attention to oral hygiene, are, or should be, a commonplace. When I was a student, one of my chiefs used to insist on male patients giving up smoking for a time before operation, a precaution which seems unfortunately to have lapsed.

Tight bandaging should be avoided. It is my practice to fix with two bits of strapping a sheet of bound copper gauze over the wound. This remains untouched until the stitches come out; the wound can be inspected through it and, although it sounds uncomfortable, it is really a most comfortable form of dressing.

Therapeutics.—Therapeutics should be directed towards removal of the offending obstruction by stimulating the patient to cough. An expectorant mixture should be given, and I find ammonium carbonate, gr. 15, given in milk, four-hourly, the best. It must, however, be remembered that coughing is painful, and the exhibition of morphia in small doses for this purpose not only is humane but constitutes no disadvantage in any other way. The patient must be stimulated to cough and, if possible, placed in a posture to assist draining the bronchus affected. Obviously, a patient after a gastrectomy or cholecystectomy cannot be expected to tolerate elevation on a postural drainage bed, but lowering from his sitting position into a lying position on his side is easily tolerated, and results are occasionally dramatic, especially in those cases in which a lobar or main bronchus is affected. If pneumonia has supervened, then rigorous treatment of this kind cannot be adopted.

Bronchoscopic aspiration is not advocated as a general rule, for the above methods are usually sufficient, and also there is a natural reluctance to submit the patient to a procedure which will be very disturbing.

The use of the carbon-dioxide and oxygen mixture has been much advocated, but it is of doubtful value; in fact, the hyperventilation produced by carbon dioxide may produce the reverse of the desired effect in driving the plug further in. Its effect lasts only a few minutes, and, in certain cases, leads to a further decrease in the vital capacity. The use of carbon-dioxide as a hyperventilating agent at the end of the operation, in order to wash out the anaesthetic, is undoubtedly of value, but the patient should be allowed to fill his lungs with air and not with oxygen. Oxygen is invaluable for controlling any anoxæmia which may be present, and it should be resorted to freely. Its use should be not intermittent, but continuous, through the medium of a tent or intranasal catheters.

Post-operative pneumonia, as previously indicated, is probably superimposed on a pre-existing collapse. The infection which is present has now transgressed the bronchiolar wall and invaded the parenchyma. The patient is necessarily more toxic and the condition more serious. Treatment should be directed—but in a much less vigorous manner, in view of the patient's general condition—to clearing the bronchial tree, by administering a stimulating expectorant and general supportive measures.

Lung abscess, when it occurs, is perhaps the most serious complication, and is treated on the same lines as those abscesses which occur apart from any association with operation.

REFERENCES

- BROOKS, W. D. W. (1938), *Brit. J. Tuberc.*, **32**, 14.
- BRAUER, L., Personal Communication.
- CARLSON, H. A. (1932), *J. Thoracic Surg.*, **2**, No. 2, 196.
- CHURCHILL, E. D., and MCNEILD (1927), *Surg. Gynec. & Obst.*, **44**, 483.
- GAIRDNER, W. T. (1850), *Month. J. M. Sc.*, **11**, 122 and 230; (1853) *Brit. and For. Med. Chir. Rev.*, **11**, 453.
- KING, D. S. (1933), *Surg. Gynec. and Obst.*, **56**, 43; *J.A.M.A.* (1933), **100**, 21.
- PASTEUR, W. J. (1890), *Am. J. M. Sc.*, **100**, 242; *Lancet* (1908), (ii), 1351; (1910), (ii), 1080; (1911), (i), 1329; *Brit. J. Surg.* (1914), **1**, 587; *Lancet* (1914), (i), 1428.
- WATERS, R. M., Personal Communication.

Dr. James Maxwell: It is customary to attribute the commencement of the clinical study of massive collapse of the lung to W. Pasteur, whose Bradshaw lecture, delivered thirty years ago, was devoted to this subject. Many advances have been made since that lecture was given, and our methods of investigation of chest disorders have been entirely revolutionized. The experience gained in the European war, and the routine use of X-rays in chest conditions, provided a mass of fresh information—which did not, however, entirely invalidate Pasteur's conclusions. These were, in the main, supported by A. B. Soltau who, in 1925, published an able review of the then existing evidence. Both of these observers concluded that massive collapse of the lung was the result of a weakness of the thoracic muscles, and that the most important element in its production was an inhibition of the diaphragm. It is true that, in 1914, Elliott and Dingley had suggested that the cause of the collapse was obstruction of the bronchus by retained secretion, but they were unable to produce convincing proof of their theory, which was not received favourably by their contemporaries. Soltau concluded that "bronchial blocking cannot be accepted as the complete explanation, although in some cases it may play a small contributory part."

The elucidation of this problem within the past ten years provides a brilliant exposition of the results which can be achieved by clinical investigation. Much of the experimental work which has been carried out on the respiratory tract of animals is vitiated by the fact that the customary position of the trachea in the quadruped is

horizontal, and that therefore the mechanics of respiration, and particularly of coughing, cannot possibly be compared in the experimental animal and in the human subject. The conclusive demonstration that so-called spontaneous massive collapse is due to retention of secretion and consequent bronchial obstruction has been furnished by the bronchoscope, and the evidence is of much greater value because it has been obtained by direct observation of the part concerned.

The evidence that post-operative massive collapse is primarily due to bronchial obstruction rests firmly upon bronchoscopic observations, which have shown in the great majority of cases thus examined a plug of mucus or of mucopus in the bronchus leading to the affected lobe. This fact is now so well established that it is not necessary to quote figures in support. It is more pertinent to consider how this bronchial obstruction is produced.

In this connexion the observations of Myerson are of value, for they throw light upon the reason for the retention of viscid material in the bronchial tree. Myerson bronchoscopied 100 patients immediately after tonsillectomy under light general anaesthesia, and found that blood was present in the bronchi in 76 cases, in all of which the laryngeal reflex was present. Of 24 cases in which the bronchial tree was clear, 18 had coughed during the operation. These results appear to demonstrate the importance of cough in keeping the respiratory tract clear; it would seem that the laryngeal reflex does not ensure the presence of cough when the pharyngeal contents come in contact with the larynx, trachea, or bronchi, and that cough only occurs under light anaesthesia when there is increased irritability of the respiratory tract. Myerson noted that blood mixed with mucus and saliva, which is of much the same consistency as the mucus secreted into the bronchi, does not activate the cough reflex, and cough is not the normal mechanism of expulsion under light general anaesthesia.

Finally it is recognized that mucus or mucopus can obstruct a large bronchus and can cause collapse of a lobe, or even of a complete lung. This has been shown to occur spontaneously in some cases of bronchitis and asthma, and the evolution of the process has been observed by taking X-ray photographs at short intervals. The process of resolution has also been observed, both after the spontaneous expulsion of the obstructive material and after the plug has been removed through a bronchoscope. It therefore appears that bland material in the bronchi may not cause an immediate cough reflex, and this is particularly true when the reflex is depressed following the administration of an anaesthetic. Of course the cough reflex becomes more sensitive as the patient recovers strength, but the plug has become firmly fixed by this time and the effort is largely ineffective, so that an irritative cough is a prominent symptom of the fully developed condition. This raises the very important point as to whether pre- and post-operative medication, with morphia and other substances which depress the cough reflex, is not an important factor in causing retention of secretion in the bronchial tract.

The factors which are mainly concerned in the causation of post-operative collapse are general weakness and debility, a bronchitic tendency, and the too-liberal use of morphia before and after operation. It is possible that weakness of the lower intercostal muscles and of the diaphragm plays some part in promoting retention of secretion, but this is a secondary factor, which appears to act by diminishing the effect of coughing, and collapse is not the primary result of diaphragmatic paralysis. The fact that the diaphragm is seen to be raised on the X-ray screen simply indicates that the muscle is displaced because of the collapse of the lung, and not that the paralysis is the cause of the collapse. Finally, conclusive evidence that phrenic paralysis is not the main cause of collapse of the lower lobe is to be found in the fact that, although numerous operations have been performed for the purpose of paralysing the diaphragm in the treatment of chest disease, spontaneous massive collapse of a lobe is a rare event after phrenic avulsion.

Although the present-day opinion stresses the importance of bronchial obstruction, it does not follow that the original view of diaphragmatic paralysis as a cause of massive collapse must be entirely abandoned. The plug of mucus obstructs the bronchus but it is necessary to go further back and to consider how the plug gets there. There seems to be no doubt that weakness of the action of the diaphragm and the intercostal muscles plays a very considerable part in the inability to expel mucus as it is formed, and therefore it appears that the two apparently opposite views can be reconciled and it becomes clear that each is equally concerned, as cause and effect, in the causation of the condition.

There are few or no symptoms in the early stages, but later there is irritative cough, with little or no sputum, and rarely any trace of blood. A common feature is pain in the chest, which may be mistaken for pleurisy; this pain is due to sudden increase in the negative tension in the pleural space. Dyspnoea is always present to some extent. In many cases there is some rise of temperature, which may reach 101° F.; this appears to be due to the retention of infected material distal to the obstruction, and it therefore indicates the possibility of developing suppuration in the collapsed area. It can be seen that the clinical state may closely simulate that in pneumonia, but there is not, as a rule, so great an increase in the respiration rate.

The earliest physical sign is weakening of the breath-sounds over the affected lobe, usually the right lower lobe. When the diagnosis is made at this stage there is every probability that preventive treatment can be successfully applied. The fully developed condition is quite easy to recognize. There is limitation of movement on the affected side, and the heart is shifted towards the collapsed area; the percussion note is much impaired and may even be dull; the breath-sounds are absent.

While it is not often possible to secure radiographic confirmation of the diagnosis in patients who are acutely ill following operation, there should be no difficulty in making sure on clinical grounds alone.

Post-operative pulmonary collapse is chiefly of importance, not on account of the condition itself, but because it may lead to serious consequences. Infection of the collapsed lobe may lead to the formation of a lung abscess, and this is one of the ways in which post-operative lung abscess may arise. In other cases the collapsed lobe may fail to re-expand and there may be a rapid development of bronchiectasis, either suppurative or haemorrhagic; it is the possibility of this complication which renders it imperative to secure re-expansion as early as possible.

The treatment of post-operative pulmonary collapse may be considered according to the stage at which the diagnosis is made. In the first place, every effort should be made to eliminate the factors concerned in the retention of secretion, and serious thought should be given to the dosage of morphia required, both before and after operation. In addition, when possible, the position of the patient should be altered at intervals in order to promote as free movement of the lower parts of the lung as possible. When the signs indicate that collapse is already occurring, more vigorous methods are necessary in order to cause the lung to re-expand. It is at this stage that inhalations of carbon dioxide are of great value. When collapse is already present, and the bronchus is completely obstructed, carbon dioxide is not likely to cause re-expansion, and its only action would be to drive the plug further into position. Fortunately it often happens that the patient spontaneously expels the obstruction and the lung expands of its own accord. If this happens before infection has taken place in the collapsed lobe, recovery should be complete. If, on the other hand, there is difficulty in ridding the bronchus of the obstruction, it is essential to pass a bronchoscope and to suck out as much of the mucus as possible. It is better to use the bronchoscope early rather than to wait until there is evidence of infection, for sometimes an infected lobe will fail to expand, even although the obstruction has been removed. In such cases there may be the clinical picture of pulmonary suppuration, and postural drainage may be desirable, although it should be remembered that this

is not always possible in patients who have recently undergone a major operation. Persistent trouble in the affected lobe results in bronchiectasis or chronic lung abscess, and the treatment is that of the established disease. Finally, it must again be urged that the best way to deal with post-operative pulmonary massive collapse is to prevent its occurrence, and that this can best be done by careful attention to the pre-operative and post-operative state of the respiratory tract.

REFERENCES

ELLIOTT, T. R., and DINGLEY, L. A. (1914), *Lancet* (i), 1305.
MYERSON, M. C. (1922), *Laryngoscope*, S. Louis, **32**, 929.
Id. (1924), *ibid.*, **34**, 63.
PASTEUR, W. (1908), *Lancet* (ii), 1261.
SOLTAU, A. B. (1925), *Brit. M. J.* (i), 544.

Dr. E. H. Rink: The term "massive collapse", when it was first introduced, was a very valuable one. It is a very striking term, and it served to call the attention of members of the medical profession to a very striking condition—and moreover to differentiate this condition from pneumonia, which, of course, may also occur after operation. It appears now, however, that the term has become perhaps too striking. It calls up a dramatic picture to the mind, and the word "massive" may cause one to forget that collapse of relatively small areas of lung may also take place, causing similar but less obvious symptoms and signs, the area of lung involved depending on the size of the bronchus obstructed. The use of this dramatic term, moreover, does not take into account those cases in which a patchy bilateral condition occurs. It is suggested, therefore, that the term "massive collapse" should be restricted to those comparatively rare cases in which at least two-thirds of one lung are affected, and that for the remaining cases the term "lobar atelectasis" and "lobular atelectasis" should be employed—thus bringing the nomenclature of the subject into line with that of the pneumonias, and also, it is hoped, making the pathology of the condition more intelligible.

The clinical aspects of this condition have been discussed so fully this evening that it appears unnecessary to make any further reference to them, except this—that it is just as important for the anaesthetist to recognize collapse when it occurs and to have a thorough understanding of the conditions that lead up to it as it is for the physician and surgeon in charge of the case.

Had this discussion taken place about fifteen or twenty years ago, its title would almost certainly have been "Massive Collapse as a complication of Anæsthesia", and its present title may be regarded as making a great advance in our understanding of the condition. We now know that post-operative collapse is caused by a large number of factors operating together, and that the type of patient and the nature or site of the operation are the most important of these. That the nature of the anaesthetic is not in itself a factor of primary importance may be illustrated by statistics. For example, Mr. Brock published in 1936 a study of 85 cases of post-operative chest complications occurring at Guy's Hospital. Of these 76 followed abdominal operations, and of the remaining nine, six were other types of complications than those under discussion. In the three cases that did not follow abdominal operations other conditions were acting in a similar manner.

Now these cases all occurred in the ordinary surgical practice of a large general hospital. When we consider the large number of non-abdominal operations which must have been performed at the same time, with all types of anaesthesia, we cannot fail to come to the conclusion that the anaesthetic itself can have very little to do with the primary causation of collapse.

A perusal of many published series of cases has shown that the percentage of all chest complications after abdominal operations is about 14% of the total number of operations performed, while after non-abdominal operations it is about 1%, and those

as a rule, other than collapse. The conclusion is plain that the fact of an abdominal section is of great importance in the causation of post-operative collapse.

It was natural at one stage to think that irritant inhalation anaesthetics, particularly ether, would have an important effect in producing chest complications. It is true that ether or any other general anaesthetic, if unskillfully administered, will do harm, and if other conditions making it likely are present, may play some part in the production of a collapse. I refer particularly to the type of anaesthetic under which the patient is straining, in spasm, possibly with a partially obstructed airway. This will cause excessive secretion from the mucous membranes of the mouth and pharynx and also of the trachea and bronchi, and thus add to the quantity of secretion to be coughed up after the operation. But there is no evidence at all that ether, in itself, plays an important part in the production of collapse.

The first important factor in the production of collapse is the type of patient. During the past eighteen months I have been dividing up the patients to whom I have given anaesthetics for upper abdominal surgery into good and bad risks, judged solely from the point of view of their prognosis as regards the occurrence of chest complications and particularly of collapse. I have done this in order to obtain information as to how far it is possible to avoid or to modify these complications in bad-risk cases. I think that the best way in which I can give an idea of what I regard as the type of patient who is liable to chest complications is to describe in some detail the criteria which I have adopted. Before doing so, however, I should like to make one point of great importance.

Ever since the nature of these complications has been realized, efforts have been made to avoid them, usually by the adoption of some single measure in all cases. I refer to such measures as avoidance of all inhalation anaesthetics, avoidance of ether, the giving of large doses of atropine, the avoidance of atropine altogether, the post-operative administration of large percentages of carbon dioxide, &c. All these single measures were doomed to failure and did fail, because those who adopted them did not realize that the cause of collapse is a number of factors working together, and that no measure aimed at any single one of them could possibly succeed.

The only way to tackle the problem is to consider as far as possible every single circumstance that is operating against the patient, and to do whatever may be feasible to combat each one, and for this purpose close co-operation between the surgeon and the anaesthetist is essential. It must be recognized, however, that whatever may be done, there are certain combinations of circumstances in which collapse is extremely likely to occur, and in such circumstances we can only be on our guard, and carry out measures directed towards making its course, if it does occur, as benign as possible.

Collapse is commoner in men than in women, in the proportion of about 3 to 1. There appear to be two main reasons for this. The first is that chronic bronchitis is commoner among men than among women, particularly among the working classes in which men have to work out of doors in all weathers, and often indifferently clothed. In the atmosphere of London at any rate, this is very liable to lead to chronic bronchitis at the time of middle age. At this time, too, the ribs of men, particularly of those who do heavy work, are apt to become fixed. And this brings one to the second reason for the difference in incidence between the sexes, namely that while in men breathing is largely abdominal or diaphragmatic in type, in women it is more purely thoracic. The consequence is that immobility of the abdominal wall caused by an operation will upset a woman less than a man. It must be emphasized, however, that a woman who for any reason has a fixed chest and chronic bronchitis is just as likely to develop a collapse as is a man.

No age is exempt from these complications. Some of the severest cases of collapse occur in children—most typically, in my experience, in boys of between 8 and 14 years of age, after operation for acute appendicitis. Children do not, of course, suffer

frequently from chronic bronchitis ; they do, however, often have an attack of acute tonsillitis preceding an acute appendicitis, and this circumstance appears to account for many of the cases. Nevertheless it seems true to say that on the whole the frequency of chest complications increases with increasing age.

The general condition of the patient is of great importance in assessing the prognosis. Patients who are enfeebled and cachectic, whether from carcinoma or from long-standing sepsis, are far more liable than healthy people to pulmonary collapse after a laparotomy. Their weakness may make it impossible to clear their chest of secretions under the additional burden of an abdominal wound. Extreme obesity involves a poor prognosis, as does also emphysema.

The condition of the respiratory system is perhaps the most important single point. I believe that in every case of collapse, even if it was not previously recognized, careful inquiry into the history will reveal evidence either of chronic bronchitis, which may only be shown by the expectoration of mucopurulent sputum first thing in the morning, or of the tail-end of a common cold or other acute respiratory infection. The consistency with which purulent or mucopurulent sputum is produced post-operatively in these cases, invariably commencing a very short time after the end of the operation, makes it impossible to believe otherwise than that the infection was already present before.

Thus infection of any part of the respiratory tract carries with it an increased risk of collapse. Dental sepsis is to be included in this connexion. Patients are still far too often submitted to operation who have heavily infected teeth. This invariably makes the prognosis worse. Besides the increased risk of collapse there is also a very definite danger of a lung abscess developing from this cause.

If sputum is present before operation, a mucoid type is of less serious significance than a mucopurulent or purulent one.

To sum up then : The worst possible prognosis from the point of view of collapse would be in a middle-aged or elderly man with a fixed chest, chronic bronchitis, and dental sepsis, suffering from advanced carcinoma. The best risks are young women with no evidence of respiratory infection, suffering from some purely localized condition. Between these two extremes, of course, there are all grades of good and bad risks.

As regards the operation itself : The operations most frequently followed by collapse are those on the upper abdomen, particularly if they involve suture of the stomach and duodenum. The length of the operation is in itself of less importance than the general condition of the patient. The operation of gastrostomy, for example, which is a comparatively short one, is very frequently followed by a collapse. The reason for this is that the patient is usually very ill and wasted before it is performed.

Next in liability to upper abdominal operations come middle and lower abdominal ones, followed by operations for hernia. Of lower abdominal operations those most frequently followed by the development of a collapse are perhaps operations for acute appendicitis. Intestinal resections also carry a bad risk.

Of abdominal operations in general, other points with regard to the patient being equal, operations for acute conditions appear more likely to be followed by collapse than operations deliberately undertaken. For one reason, in acute cases there is no possibility of carrying out preliminary prophylactic treatment, but more important still are the facts that the patient may be very ill and toxic at the time of the operation and that drainage has frequently to be employed, with subsequent infection of the abdominal wall. The presence of a drainage tube must of necessity lead to a decrease in the possibility of abdominal movement and is often the determining factor in the development of a collapse. This accounts for the frequency of the condition after operations for appendix abscess.

No non-abdominal operations lead in the same way to immobility of the abdominal

wall and diaphragm ; they therefore practically never lead to collapse even in patients who would be very bad risks if they were subjected to a laparotomy. It is true that operations other than abdominal may lead to bronchitis or even occasionally to bronchopneumonia, but on the whole the risks are very much less than in the case of abdominal surgery.

The prophylactic measures which may usefully be taken, follow naturally from the points which have just been considered. It is obvious, for example, that greater care must be taken before an abdominal operation than before any other. Nevertheless, the procedures to be recommended will all be of value from other points of view than that of the prophylaxis of collapse, and may be profitably adopted in all types of case.

The first thing of importance is to make an assessment of the patient on the lines that have been indicated. If the patient represents a good risk from every point of view, there is nothing more to be done in the pre-operative phase.

If, however, the patient turns out, from any of the points of view mentioned, to be a bad risk, there are then various steps which may be taken to improve the prognosis. A factor which is of great importance, and one which to my mind is not sufficiently stressed, is the selection of the best time for operation. Far too often patients are admitted to hospital or to nursing homes for a big operation to be performed the next day, and if for any reason a postponement is suggested, hostility is often encountered from the patient and his relatives, and also from the medical attendants. One must sympathize, of course, with the anxiety of the patient and his relatives to get the unpleasant experience over as soon as possible, but on the other hand the benefits of a few days in bed, or at any rate of rest, before a severe operation, may be very great.

When chronic bronchitis with expectoration is already present, the prognosis as regards the occurrence of collapse must of necessity be bad. But even in such cases much may be done by a few days' rest in bed and the judicious use of expectorants and inhalants. Where acute infection has been recently present it is highly desirable to postpone any operation, but absolutely essential in the case of an abdominal one. Any septic foci in the respiratory tract, such as infected tonsils or sinuses, should receive attention before an abdominal operation. Bad teeth must also be attended to.

One point that must be stressed is the great benefit to be derived from breathing exercises, more especially in the case of men. As has already been mentioned, one reason for the liability of men to collapse of the lung is that their respiration is mainly diaphragmatic in type. A short course of breathing exercises will often train them to use their intercostal muscles more efficiently and thus save them from a good deal of post-operative trouble. It is, however, useless to apply this measure to a patient with gross fixation of the costo-vertebral joints.

It would be thought that the time of year would play an important part in the incidence of chest complication, but actually this is not so. It is true that bronchitis is more severe as a rule during the winter weather, but latent bronchitis may be just as potent a factor. Some of the severest cases of collapse occur during the hot dry weather of summer. The explanation probably is that the bronchial secretions become more viscid owing to the increased fluid loss from the lungs, and that there is therefore greater difficulty on the part of the patient in coughing them up. On the whole spring is probably the most favourable time, but too much stress should not be laid on this point.

Of the precautions that may be taken during the operation itself to prevent or to minimize the severity of a collapse, the first to receive attention is the choice of anaesthetic. It has already been stated that this is not a very important factor in the production of collapse, and in good-risk cases this is true. In the series of cases which have been under personal observation, not one of those which were classed as good risks has developed collapse, and these patients have had upper

abdominal operations performed under several types of general anaesthesia and also under local and spinal anaesthetics. However, it is too early to dogmatize on this point, as the series is not a very long one. But in the case of patients with a poorer prognosis, then the choice of anaesthetic may be of some importance ; if one makes a correct choice, combined with the preliminary measures suggested, it may often be possible altogether to avoid a collapse which there was good reason to anticipate, and to reduce it, if it does occur, to a negligible severity.

When spinal anaesthesia first became a practicable proposition for abdominal surgery, it was hoped that it would immediately abolish all chest complications. As is now known this was not, and never could be, so. The pendulum, however, has swung in the opposite direction, and many writers and observers are of the opinion that chest complications are actually commoner after spinal than after general anaesthesia. This opinion is often based on figures which are certainly highly suggestive, but there is a great fallacy in them. They fail to take into account that it is just in the bad-risk cases that spinal anaesthesia has been most used, and that in these cases chest complications would have developed whatever anaesthetic was employed. When in strictly comparable series of cases general and spinal anaesthetics are given, it is found that there is no difference at all between the two as regards the incidence of chest complications.

The main argument against spinal anaesthesia from the point of view of the present discussion, is that it paralyses the lower intercostal muscles just when they are most needed. It would appear, however, that it is just in cases in which these muscles have very little action already that pulmonary collapse is most likely to occur, and that further paralysis will make little difference. Moreover, it seems to me that the effect of this paralysis is less harmful than the respiratory depression and absence of cough reflex which occur in general anaesthesia. Thirdly, many observers will agree that collapse is just as common after local anaesthesia, when there is no intercostal paralysis.

In my opinion the point is not of great importance. It seems that the conditions which favour the occurrence of collapse occur not so much during the operation as in the first hours following it, and therefore that the presence of a full cough reflex at that time outweighs many other considerations.

My view is, therefore, that in a patient suffering from bronchitis and undergoing an upper abdominal operation, it is better to give a spinal anaesthetic if the general condition permits it. There are, however, many cases in which other considerations have to outweigh that of the chest—where for a variety of reasons a spinal anaesthetic may be considered dangerous. In such cases, if it is feasible, local anaesthesia would appear to be the wisest choice. My own observations and those of others have led me to believe that collapse, when it occurs after spinal or local anaesthesia, usually is of a more benign type and is less likely to be accompanied by an infective process.

When local and spinal anaesthesia are contra-indicated, we must consider what form of general anaesthesia is likely to be least harmful to a bad-risk case. Earlier on the view was expressed that it is on the whole wiser not to give ether to patients who are bad risks from the point of view of the chest. I think that this is so, nevertheless more harmful than giving a little ether is an attempt to strain the possibilities of nitrous-oxide-oxygen anaesthesia without it.

Whatever general anaesthetic is given to these patients, it is important that recovery from it should be as rapid as possible. For this reason it seems best that it should be supplemented, wherever possible, by local infiltration of the abdominal muscles. By this means trauma will be avoided, and the anaesthetist will be enabled to use far less of whatever agent he has selected.

Cyclopropane has been advocated as a very good anaesthetic for bad-risk abdominal cases, and a limited experience leads me to agree with this. The one disadvantage

appears to me to be that after a long deep anaesthesia recovery may be delayed as long as it is with ether. But if it is combined with local anaesthesia, so that the general anaesthesia can be kept at a light level, this objection disappears, and recovery is almost as rapid as from nitrous oxide.

Divinyl ether, or vinesthene, being non-irritant and very potent, is also an excellent agent for use in these cases.

As regards basal anaesthesia, I feel that in bad-risk cases, long-acting drugs such as avertin should not be used, as the delay in recovery may be considerable. The drugs with a shorter action, such as evipan and pentothal, may, however, be used with impunity for induction. In good-risk cases, there is no objection at all to the use of any form of basal anaesthesia.

Before leaving this part of the subject, it should be emphasized once more that the fact of anaesthesia in itself cannot cause a chest complication, but that the unskilful administration of an anaesthetic may be an important factor in the chain of events leading up to an atelectasis. Straining on the part of the patient, and excessive secretion in the respiratory passages, must both be rigorously avoided if the patient is to be protected against the risks laid on him by his own physical disabilities.

In the post-operative stages, the first important point concerns the bandaging of the patient. The tight many-tailed bandage, so much loved by members of the nursing profession, may be extremely dangerous to the patient, and by constricting the lower part of the chest, may be the determining factor of an atelectasis. It is far better for the dressing to be fixed by well-placed strips of adhesive plaster. This point may also be of importance in connexion with the surgery of the upper limbs. Mr. Brock has described two cases of typical pulmonary collapse which were attributed to injudicious splinting of the arm to the chest wall and cleared up immediately this was corrected.

As soon as the patient has recovered from the initial shock of the operation, he should be encouraged to move about the bed as much as his condition permits. He should also be encouraged to cough whenever he feels that he has sputum to bring up. It has been said that the patient who gets a pulmonary embolism is the one who bears his operation with Christian fortitude. The same is true of pulmonary collapse. The very fact of changing his position in bed is often sufficient to enable a patient to clear his chest when previously he could not do so.

It is not always realized that, although it is easy for a patient to breathe when sitting upright in bed, it may be very difficult for him to cough effectively in this position. It is therefore very important, in the first days after the operation, that he should be laid flat in the bed at least twice a day, and encouraged to cough, lying first on one side and then on the other. For this manœuvre all pillows should be removed, except possibly one under the lower part of the chest. If, as is likely, coughing is painful, the nurse should support the abdominal wound to afford relief. I have several times seen a patient who appeared to be on the verge of a lung collapse, and who was sitting up in bed and coughing ineffectively, with a slightly raised temperature, immediately relieved by this postural coughing. This is also the best and most effective treatment of the collapse itself, when it has occurred.

The use of atropine in relation to anaesthesia has been hotly debated from time to time. Personal observation has suggested that its pre-operative use may be very beneficial from several points of view, and that it is to some extent useful in the prophylaxis of chest complications, in that it helps to prevent excessive secretion during the course of the anaesthetic. Post-operatively, however, there is no question at all but that it is harmful and should never be used. Its only effect is to make the sputum more viscid, and consequently more difficult to cough up.

The question of carbon dioxide is a very vexed one. This agent is undoubtedly of benefit in certain phases of the condition, but in certain others it seems that it may be definitely harmful. In the case of a patient with a large amount of purulent sputum which he has difficulty in expectorating, the inhalation of carbon dioxide appears to be just as likely to cause him to block a bronchus by violent inspiration, as to clear it by expiration. Moreover, the inhalation of large percentages of carbon dioxide is extremely unpleasant and may be a terrifying experience to a very ill patient. My present practice is to give short inhalations of it in the immediate post-operative phase, if respiration is unduly shallow. Later it may be given for a short time before the commencement of postural coughing, to which it does appear to be an adjuvant, but not in greater concentration than 7%. Apart from this, my personal feeling is that it should only be used as a last resort in the most serious cases of collapse which are not yielding to ordinary treatment.

Morphia is a very valuable drug in connexion with pulmonary collapse and its prevention. One of the reasons that post-operative patients do not cough effectively is that it may be extremely painful for them to do so. In such cases the administration of an adequate dose of morphia half an hour before the commencement of postural coughing may be of the greatest value. So far from unduly depressing the cough reflex, such administration often results in a complete and painless evacuation of the bronchial secretions.

Expectorant drugs do not play a very large part in this subject. Occasionally, in a patient with very tenacious sputum, five-grain doses of potassium iodide will be of assistance, but, in general, expectorants merely increase the amount to be coughed up, without making it any easier for the patient to do so.

Dr. H. Joules said he would like to deal briefly with that small proportion of cases in which massive collapse was not due primarily to bronchial obstruction. Paralysis of the phrenic nerve, resulting from mediastinal pleurisy secondary to central pulmonary infection, was probably not infrequent. This led to a markedly high position of the diaphragm and was associated with a collapse-consolidation of the lower lobe of the lung on the affected side. Two cases had been seen during the past twelve months and seemed worthy of detailed description.

I.—G. T. K., male, aged 20. A retrocaecal acutely inflamed appendix was operated upon, December 15, 1936, under open ether anaesthesia. Subsequently a pelvic abscess developed and was followed by evidence of intestinal obstruction. A second operation, under spinal stovaine anaesthesia, was performed on January 6, 1937. The obstruction was relieved, and gradual improvement followed.

On January 15 there was a sudden attack of cyanosis with paroxysmal unproductive cough, and severe pain at the tip of the left shoulder and on the outer aspect of the upper third of the left arm. Temperature 102° F. Signs suggested collapse and localized pneumothorax.

A skiagram revealed central consolidation of the left lower lobe, with collapse and complete paralysis, and a high position of the diaphragm (fig. 1, p. 88).

Paroxysmal cough and more urgent symptoms yielded to treatment by sedatives and oxygen. Temperature subsided in seven days. On February 8, 1937, the patient was symptomless, and a skiagram showed a much lower position of the diaphragm and that the lung was clearing (fig. 2, p. 88).

Complete restoration of normal diaphragmatic movement was confirmed subsequently by screening of the chest.

II.—W. T., male, aged 31. Operation March 14, 1937. A perforated gastric ulcer was found high up on the lesser curvature. Pre-operative omnopon and atropine were given and were followed by spinal percaïne, 14 c.c., and open ether. Twenty-four hours later generalized bronchitis and bronchiolitis developed. Temperature 99.6° F.; respirations 32.

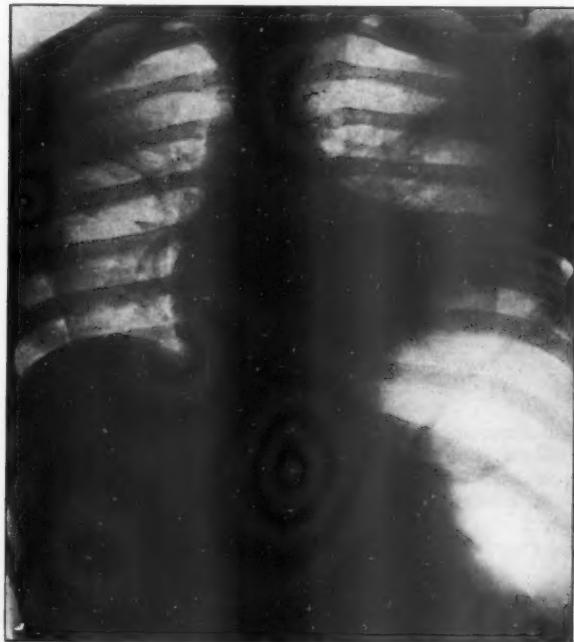


FIG. 1.—Case I.—Massive collapse of left lower lobe. Note unusually high position of diaphragm on this side.

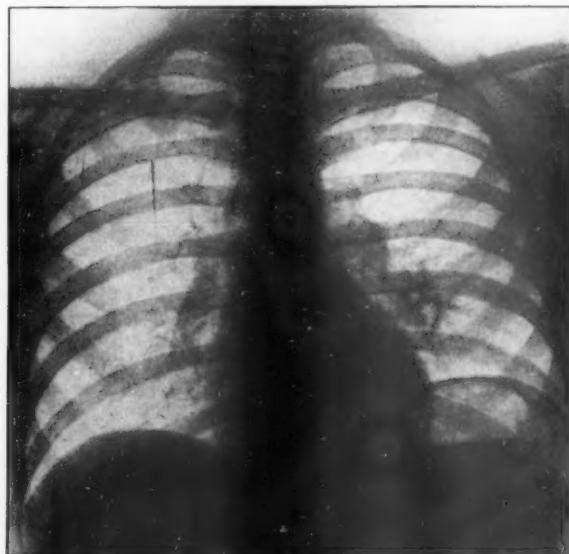


FIG. 2.—Case I.—Re-expansion of left lower lobe. Diaphragm lower in position.

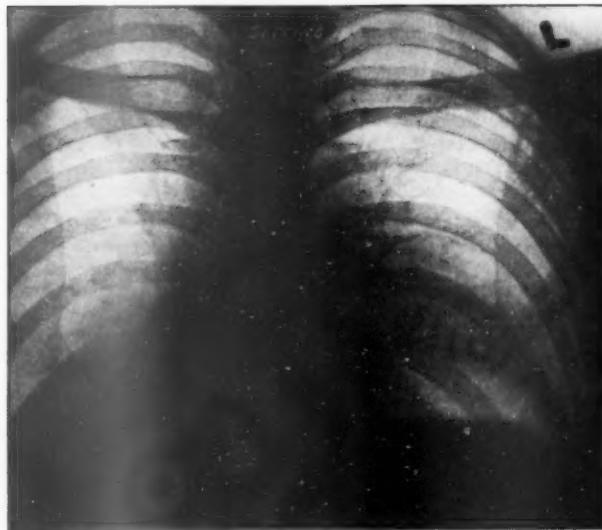


FIG. 3.—Case II. Massive collapse of left lower lobe. Consolidation right lower lobe.
Note high position of left diaphragm.

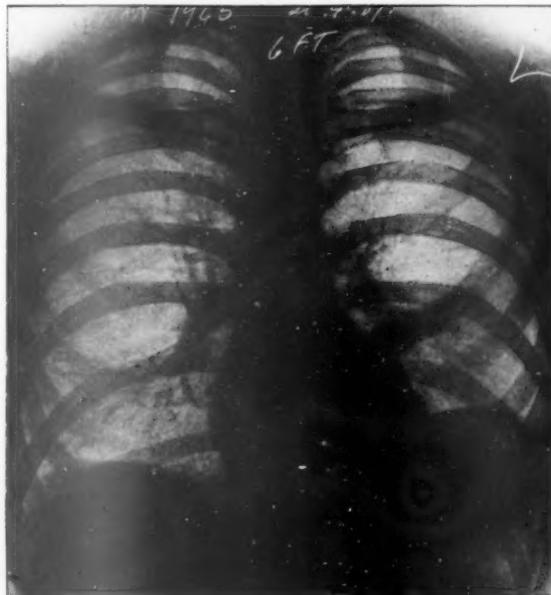


FIG. 4.—Case II. Re-expansion of lung and resolution of the inflammation.

On March 22 the cough and cyanosis were increasing and there was pain in the tip of the left shoulder and the upper third of the outer aspect of the left arm. Temperature 102° F.; respirations 32. Signs of bronchopneumonia were found in the right lung—weak breath-sounds and pleural friction in the left mid-axilla. Twenty-four hours later the pain, cough, and cyanosis, had increased, and examination revealed hyper-resonance from the third left interspace anteriorly to the 7th rib in the mid-scapular line. The heart was misplaced to the right, and pericardial friction was now audible. A diagnosis of left phrenic paralysis associated with collapse-consolidation of the left lower lobe, pericarditis, and right bronchopneumonia, was confirmed by a skiagram (fig. 3, p. 89).

Despite a very severe illness, recovery gradually ensued, and a skiagram taken on 21.4.37 showed a marked progress towards normality (fig. 4, p. 89).

Neither of these cases would be confused with the more common type of massive collapse, owing to the longer time of onset after anaesthesia, and the completely differing physical signs and distribution of pain. It seems probable that this condition is more common than is usually appreciated.

Dr. Ranyard West drew attention to the sudden generalized collapse of the lung which occurred in curarine poisoning. He described the mechanism of this in experimental animals and thought it worth noting that the fall of negative intrapleural pressure resulting from paralysis of the diaphragm had a counterpart in very deep ether anaesthesia. It was true that in the collapse of the lung produced by curarine there was an added factor—that of bronchial spasm—which was not present in the case of anaesthetics, but examination of animals seemed to show that a bronchospasmodic action of curarine could only produce collapse of the lung in the presence of a fall of negative intrapleural pressure such as deep anaesthesia might produce.

The effect of posture on intrapleural pressure, particularly when the diaphragm had become weakened, was a point to be noted. The administration of atropine appeared to lessen the risk of pulmonary collapse by diminishing any bronchoconstrictor element which might be present in its causation. Bronchial obstruction occurring under experimental conditions in animals—e.g. the presence of blood-clot in the trachea—would cause collapse of the exposed lungs.

Dr. Leonard Findlay said that he had seen quite a number of examples of spontaneous collapse in childhood and these had not led him to the view that bronchial obstruction, at least by mucus and mucopus, was an important aetiological factor.

In the first place, he would like to state clearly what he meant by spontaneous collapse. This he defined as collapse of a lung, or part of a lung, which developed without any apparent cause, such as the inhalation of a foreign body or in consequence of an operation. In the second place, there seemed to him two facts which ought to be borne in mind when drawing analogies between spontaneous collapse and post-operative collapse. In the post-operative variety the radiological picture seldom or never showed the sharp margin of the shadow so constant in the spontaneous type (this of course might possibly depend on the extent of the lesion) and, so far as he was aware, bronchiectasis, so frequently described as a sequel of spontaneous collapse, had never been reported following post-operative collapse. At any rate, the history of any example of bronchiectasis which he had observed did not date from an operation.

He would again emphasize his statement that his study of spontaneous collapse did not support the contention that obstruction by mucus or mucopus played the chief aetiological rôle. It seemed to him a significant fact, that collapse seldom occurred after tonsillectomy, as was admitted by all the speakers, whereas if there was one type of operation in which secretions should find their way into the bronchial

tree and possibly cause trouble, it would be those of the nasopharynx. Dr. Maxwell had deprecated the administration of anything which would interfere with coughing, and its early appearance he had taken to indicate the presence of some foreign material in the trachea. He (Dr. Findlay) agreed that cough was an early symptom, in fact it was such an early feature that he could not escape the conclusion that it really antedated the collapse. In all his own cases the onset had been with a most uncontrollable cough. Again, in contrast to Dr. Maxwell, he had frequently noted over the collapsed area a most intensely tubular or even amphoric respiratory murmur and whispered pectoriloquy, rather than the usually described deficient or absent breath-sound.

But his chief argument against obstruction by mucus or other material in the bronchial tree being the cause of collapse, was the means by which re-expansion of the lung could be easily induced. He always treated these cases by inducing hyperpnoea from the inhalation of carbon-dioxide, and he had seen re-expansion of the lung occur almost at once. The physical signs had completely changed by the time the child had recovered from the attack of hyperpnoea, and the radiological features had in great part disappeared by the time he was taken to the X-ray department.¹ Surely, if obstruction by a plug of mucus in the bronchial tree was the aetiological factor, the deep inspirations induced by hyperpnoea would have sucked this obstruction into a more distal, and hence narrower, section of the bronchus, and thus have caused a more complete obstruction than ever.

Mr. John Hunter: That there are numerous factors at work in producing collapse there can be little doubt. The mucous secretion of the bronchial tree after the administration of atropine becomes of an extremely tenacious character, and I feel sure that it produces a plug which can only be displaced with great difficulty and, if causing a total block of a bronchial tube, is a potent factor in collapse.

I recognize a type of case in which, twenty-four hours after operation, the patient has a rapid rise in temperature, with increased pulse and a slight frequent irritating cough. Such, I think, is unquestionably a case of pure collapse, and if it is treated with "carbogen" at once the lungs usually re-expand, and there is a fall of temperature and pulse-rate within from twenty-four to forty-eight hours afterwards. If, however, chest symptoms do not appear until forty-eight hours after the operation, other factors than pure bronchial obstruction—most probably infective factors—are at work, and the clinical course of the disease is longer and more serious.

I consider that a firm lower abdominal bandage and small quantities of morphia ($\frac{1}{8}$ gr.) are most useful aids to a patient in reducing pain on coughing and deep inspiration.

The Chairman said he believed that post-operative collapse of the lung was certainly more frequent now than in the past, and he felt sure that its occurrence bore some relation to the degree of pre- and post-anæsthetic medication and to the use of intratracheal tubes. He did not think it was a good thing for a patient to arrive in the anæsthetic room in a sort of comatose condition, and it was certainly very serious for such a patient to lie in the same state for hours after returning to the ward. He felt sure that the vomiting and coughing, which were such constant sequelæ of anæsthesia in the old chloroform and open-ether days, really saved the patients from some of the lung troubles under discussion. Patients usually made the best eventual recovery if there was a certain amount of vomiting and coughing during the first few hours, and if they were "feeling pretty cheap" on

¹ See *Proceedings*, 1932, 25, 407 (Sect. Dis. in Child., 17).

the day after operation. He thought that in the after-care of operation cases *the only indication for morphia was pain.* For mere discomfort or restlessness, aspirin or sodium bicarbonate often worked like a charm and, at least, such simple remedies could not be blamed for doing away with the reflex cough mechanism. Often, after operations patients required to cough, and for this reason he considered it important that for the first few hours after every abdominal operation a firm bandage should be used. To dispense with a bandage during the coughing and vomiting stage was very unwise, and was also, he thought, rather cruel.

5